INTERNATIONAL
HELLENIC
UNIVERSITY

Prepare a marketing plan for the product sFlow

Georgios Papantonakis

UNIVERSITY CENTER OF INTERNATIONAL PROGRAMMES OF STUDIES

SCHOOL OF SCIENCE AND TECHNOLOGY

A thesis submitted for the degree of

Master of Science (MSc) in Strategic Product Design

February 2021
Thessaloniki – Greece

Student Name:	Georgios Papantonakis
SID:	1106190016
Supervisor:	Associate Prof. Konstantinos Indounas

I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

February 2021

Thessaloniki - Greece

Abstract

This dissertation is written as part of the MSc in Strategic Product Design at the International Hellenic University.

Noesis Solutions is a small-medium international enterprise with worldwide presence in the Simulation and Analysis industry. Noesis' main business is to sell software and services. The product portfolio of the company is quite limited currently with only one product called Optimus. Noesis is a growing company that sells in several regions such as China, Japan, and Europe and in several industry segments such as automotive, aerospace and electronics. Although its small size, it currently competes with much bigger software vendors that are leading the simulation and analysis market.

The market research that is conducted as part of this dissertation confirms the interest of the simulation and analysis market for the digitalization of the product development and the absorption of new technologies such as cloud. Consulting the market research results, Noesis is introducing a new engineering platform in the market with the name sFlow.

With the introduction of sFlow, Noesis is expanding the product portfolio with a second product that can host multiple engineering applications and cover various user needs. Using competitive pricing schemes, such as leasing and pay-as-you-go, and an already established distribution network that is expanded with the offer of sFlow as SaaS, Noesis expects to strengthen its position in the competitive simulation and analysis market and increase its annual revenue.

The current marketing thesis is presenting all the steps needed to create a marketing plan. A marketing audit, with analysis of the internal and external environment of the company, a SWOT analysis, a primary market research, the marketing objectives, the product mix, the action plan, and the budget are the main components of this marketing plan.

Keywords: marketing plan, Noesis Solutions, sFlow, objectives, product mix, strategy

Preface

This master thesis is a result of months of work at International Hellenic University (IHU). During my entire studies at IHU I met many people, my classmates, that without their contribution, the completion of this MSc in Strategic Product Design would be far more difficult. Their support during the last months that I was writing this text is sincerely appreciated and I am very grateful to all of them. I would like to express my deep appreciation and public acknowledgment to Ass. Prof. Konstantinos Indounas, for providing guidance and sharing his thoughts during the last months as the mentor of this master thesis. Additionally, I would like to thank my family. Without their support anything of my achievements until today would not have taken place.

Giorgos

22/02/2021

Contents

List of Images

List of Tables

Chapter 1: Introduction

Research in the marketing field has indicated that the marketing planning can contribute significantly to the business success. A marketing plan can help to identify the opportunities and threats, prepare for changes, create and/or maintain competitive advantage and create a consistent approach within the organization. To create a realistic plan, one must consider the existing competitive position of the organization, the future position, the capabilities, and the environment that the organization faces. Considering all the above, strategic marketing planning creates the guidelines that an organization uses to formulate strategies, given that they are adapted to the organization's characteristics and the environment.

The goal of the current dissertation is to create a marketing plan considering Noesis Solutions, a company that is in Belgium. In a rapidly changing environment, due to political, economical, and technological challenges and considered that the COVID19 pandemic is not over, this text presents a marketing plan that Noesis will follow to explore new markets, strengthen its position to the market and increase the annual revenue.

As part of this thesis, a research has been conducted to explore the current situation in the market that the company is active. Using internal data, a detailed analysis of the environment of the company is presented. Additionally, a wide investigation is performed to reveal which political, economical, and technological situations are currently affecting the company and may affect in the future. Considered this investigation, a main market research is planned to identify the market trends in various regions and various industries and reveal opportunities for Noesis.

Based on the analysis of the collected data, a marketing plan is structured for new products with characteristics that satisfying the target markets and customer profiles. A detailed analysis estimates the cost, sets an action plan and a monitoring system to ensure the success of the plan. Since a marketing plan is not "written in stone", a few alternatives are presented.

The main text is separated in three main chapters. The first chapter, the current chapter, is the introduction of this assignment and an overview of the structure and the goals. The second chapter presents the theory review, where the main steps that need to be followed to structure a marketing plan are described. The third chapter, which is the main one presents the actual marketing plan. It is split in the four main phases of the marketing plan as it is

described in the theory review. The first phase gives an overview of the corporate objectives and values. The marketing plan needs to be aligned with those. The second phase reviews the current situation. One of the important parts of this marketing plan is the secondary data collection with an analysis of the internal and the external environment of the company. Additionally, a primary data collection is organized with a market research that is performed with the use of a research method. The third phase of this plan presents the strategy that is followed based on the results of the phase 2. It contains the set of the marketing objectives, the marketing mix, and the analysis of the alternative scenarios. The marketing plan ends with the phase four that is showing the resource allocation and the monitoring system. A detailed action plan with a timeline and responsibilities, a budget and the monitoring mechanism are part of the final phase of the marketing plan.

Chapter 2: Theory review

This section is a review of definitions related to marketing from the perspective of different authors.

What is a strategy?

In the literature it is possible to find different definitions about the strategy and many of them are from different perspectives. Currently there is no specific and final definitions. Generally, a strategy can be considered as a collection of ideas, theories and tactics that form a plan to achieve goals that is related with the scope of the strategy. There are 3 principles that form the strategic positioning:

- Strategy is the creation of a unique and valuable position, involving a different set of activities
- Strategy requires you to make trade-offs in competing—to choose what not to do.
- Strategy involves creating "fit" among company's activities [1]

In the scope of this assignment, we are interested in the definition of the marketing strategy which focuses on gaining long term advantage at the level of the organization or the business unit. [2]

Marketing plan theory review

The marketing plan is the roadmap to implement business ideas and measure the success along the way. The plan is often a written document that gives a thorough description of the business, the customers, the competition, the marketing strategy and a budget to materialize all the activities.[3]

The Figure 1 illustrates the several stages that must be completed to define a marketing plan. This illustrates the difference between the process of marketing planning and the actual plan itself, which is the output of the process [4]. Each of the process stages illustrated in the Figure 1 will be discussed in more detail later in this assignment. The process to create the final plan assumes that some of the steps will have to be repeated more than once before the final plan can be written.

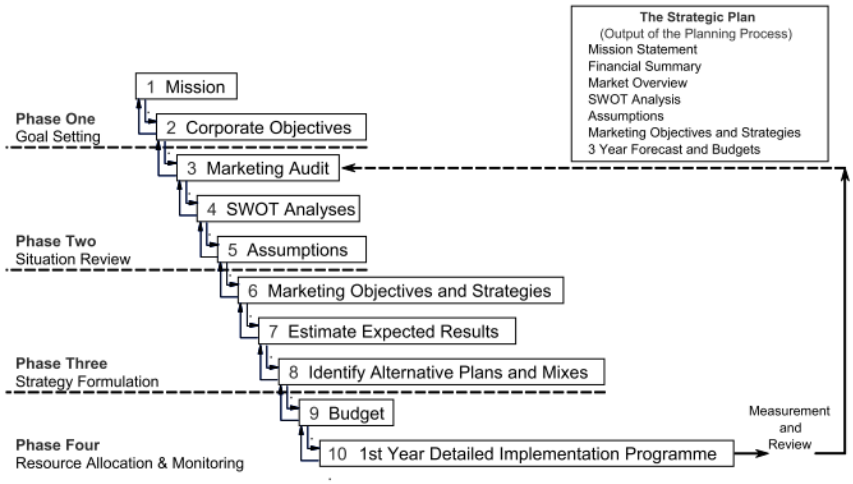

Figure 1: The steps of the marketing planning process[4]

The Steps 1&2 are contained in the Phase 1 of the marketing plan. Phase 1 is called "the Goal setting".

Step 1: Mission statement

The Figure 1 shows that each marketing plan begins with the mission or purpose statement. It is a quite difficult task to be accomplished due to the philosophical and qualitative nature of it. Although, it needs to be well defined to ensure that all the departments of an organization are aligned to the same direction. To achieve that a mission statement should be short and should contain a) the role or contribution definition, b) the business definition, c) the distinctive competences and d) indications for the future.

Step 2: Corporate objectives

The corporate objectives contain the following elements:

- The target goal of profitability
- Business related framework
    - Which products will be sold to which markets
    - Which new facilities will be needed and developed
    - The size and characteristics of the labor force
    - Financial topics
- Other corporate objectives, such as social responsibility, corporate image, stock market image, employer image, etc.

The Steps 3,4 &5 are contained in the Phase 2 of the marketing plan. Phase 2 is called "the situation review".

Step 3: The Marketing audit

A marketing audit is a systematic analysis of all the external and internal factors that have affected a company's commercial performance over a defined period. [4] During the audit, a detailed examination of the factors that the company has no direct control (external) are examined. There are 3 main factors to be examined:

- Business and economic environment (political, economic, social, technological)
- Market (size, growth, trends, prices, distribution channels, customers, industry practices)
- Competition (major competitors, size, market share, reputation, distribution policies, etc.)

Additionally, the factors that the organization can control completely (internal) are usually the firm's internal resources. The main factors that are examined are:

- Sales
- Market shares
- Costs and profits
- Marketing mix (product, place, price, promotion)
- Main strengths and weaknesses

This step, that appears in the final marketing plan, should show:

- An overview of the market
- The way the market works
- The key decision-makers
- The market segmentation highlights

Market definition is key for the success and must be made in terms of market needs and preferable not in product/service terms.

Step 4: SWOT Analysis

One of the goals of the analysis is to indicate what are the company's marketing objectives and strategies. The major findings of the analysis can be presented in a format that is clear. This can be the SWOT. The SWOT acronym stands for Strengths and Weaknesses as they related to the Opportunities and Threats in the marketplace. The strengths and the

weaknesses usually refer to the company and the products, whereas opportunities and threats refer to external factors where the company does not have control. The end goal is to exploit the strengths, try to overcome the weaknesses, grasp new opportunities and defend against threats.[5]

Step 5: The Assumptions

A real plan is based on a clear set of assumptions. Those can relate to external economic factors, technological or competitive factors. Assumptions should be few and ideally a marketing plan should be made irrespective of assumptions.[6]

The Steps 6,7 & 8 are contained in the Phase 3 of the marketing plan. Phase 3 is called “the strategy formulation”.

Step 6: Marketing objectives and strategies

The next step in marketing planning process is to define and document the marketing objectives and strategies. An objective is defined as what the company wants to achieve, and the strategy is the way to go there.

A marketing objective is related to the balance between the corporate products and the markets. It answers the question, “which products are sold in which markets”.[7] The marketing objectives relate to any of the following[6]:

- Selling existing products into existing markets
- Selling existing products into new markets
- Selling new products into existing markets
- Selling new products into new markets

To maximize the impact of the marketing objectives, they should be specific, measurable, achievable, realistic and time bound.

A marketing strategy includes methods that are chosen to achieve specific marketing objectives in the timescale that is defined. Marketing strategies are generally concerned with policies of the four P’s, Product, Price, Place and Promotion. There are different types of strategies that include different levels of risks that are also evaluated.

Step 7 and 8: Estimate expected results and define alternative plans and mixes

The completion of the step 6 of this market plan is a major and important task. In stage 7 it is expected that a judgement on the expected results is performed. This can be done based on analogous experiences, field tests, etc. The end goal is to evaluate the feasibility of the objectives and the strategies defined during the previous stage.

The marketing plan is created based on the analysis of various factors as it is mentioned during the previous steps. It is likely that during the implementation of the plan, some of the factors may change and the plan needs to be adapted. It is highly recommended to define alternatives in advance that can replace parts of the initial plan in case this is decided.

The Steps 9 and 10 are contained in the Phase 4 of the marketing plan. Phase 4 is called “resource allocation and monitoring”.

Step 9: Budget

One of the last steps to complete the marketing plan is to estimate approximately the costs that are related with it. If the marketing plan refers to the entire company, all costs should be considered. In case the marketing plan refers to a product, only the costs and the profits related to that should be considered. The budget includes several costs such as product design, packaging, delivery, and communication costs. There are several methods available to estimate the budget depending on the special needs of an organization.[6]

Step 10: Implementation of the plan

The last step of the marketing plan has to do with the concrete actions that are defined to implement the plan. It refers to concrete list of actions related to the budget, the timeline, the assignment of responsibilities and other actions as defined during the previous steps of the marketing plan.

Chapter 3: The marketing plan – Noesis Solutions

Phase 1: Mission, values, and corporate objectives

Noesis Mission

The mission statement of a company describes all the reasons for its existence and it is a statement of its fundamental purpose. [8] Noesis Solution (from now on referred as Noesis) is a company that is active in the Simulation and Analysis industry (part of the general Computer Aided Engineering industry) with focus on design optimization. The mission statement of Noesis is as follows:

"Empowering our customers to deliver cutting-edge products through industry leading design optimization technology and unmatched customer service."

Noesis Vision

Noesis has also defined a vision statement. The vision statement is different from the mission statement even though it is often confused. A vision statement is a description of a future direction for the organization.[8] The vision statement of Noesis is as follows:

"To be the first choice and most trusted partner for businesses in search of optimization solutions and beyond…"

Noesis Values

The company has set core values that define the culture internally and externally. The major values of Noesis are:

- **Respect.** It is not just limited within the Noesis team, but extends to the customers, the business partners, the competitors, the families, the friends and the community
- **Customer centric.** Noesis supports the ideology that every business process starts and ends with the customer satisfaction in mind. In fact the corporate culture resolves around this
- **Teamwork**. The commitment to common goals is based on open and honest communication and transparency, while showing concern and support for each other.
- **Professionalism**. The consistent application of altruism, excellence, caring, ethics, respect, and communication helps Noesis to achieve optimal results in all areas.

- **Empowerment**. Noesis believes in empowering the employees to take the initiative in decision making and problem solving to improve organizational efficiency and performance
- **Diversity**. The diverse team of Noesis allows it to combine a wide variety of skills, experience, and ideas to accelerate innovations and creativity in meeting customer requirements.

Noesis objectives

Noesis management has set specific corporate goals for the next 3 years. The guideline that is set for the next 3 years is that Noesis becomes a key player on the digital transformation. Receptivity and innovation need to propel the company forward. Additionally, Noesis wants to create tight relationship with customers and assist them as a strategic partner to advance their engineering processes and product development. Concretely, the company has set goals to have 15%, 22% and 33% annual revenue growth for the next 3 years, respectively. Noesis needs to maintain a minimum 15% annual operating profit. Additionally, the revenue of Noesis consists mainly of existing business (in terms of maintenance) and new business (new customers + projects). Noesis has set as a goal to keep a 45% ratio for new business over existing business for all the products of the portfolio.

Noesis has decided to invest the following years on recruiting members for the product business unit. Employees' profiles such as Product Managers, Business Analyst, Marketing experts, Product Owners are profiles that will staff the Product division. This is aligned with the goals of Noesis to grow 20% the current team the next 3 years.

Phase 2: Situation review

Noesis Marketing Audit

Noesis Internal environment

Noesis is founded in 2003 as a spin-off company of LMS NV located in Leuven, Belgium. LMS was an international engineering company that worked in partnerships with automotive, aerospace and manufacturing industries. It was producing 1D and 3D simulation software with focus on system dynamics, sound quality, noise vibration etc. An internal department of LMS that was specialized in process integration and design optimization after 1996, is where the idea of Noesis was born. After 2003, Noesis is born and it is headquartered in Leuven,

Belgium too. In 2011, Noesis was acquired by the Cybernet Systems, which is the owner until today.

Cybernet Systems Co is a technology company from Japan that provides CAE software and services. It is a subsidiary of Fujisoft Inc. Currently Cybernet Systems offers a wide variety of products and solutions. They cover a big spectrum of solutions from mechanical, electrical, medical CAE to CAD/PLM solutions, IT services and data visualization solutions[9].

Since 2000, Cybernet Systems is acquiring several companies to form the Cybernet Systems Group. The subsidiaries are separated in Sales subsidiaries that are located in China, Taiwan, Korea and Malaysia and the Development subsidiaries that are located in USA, Canada and Belgium.[10] Noesis is the development subsidiary in Belgium.

Noesis is a small-medium sized company that operates in different locations worldwide. The headquarters are in Belgium. In the Belgian office, HR, development, sales, and the management teams are operating. Additionally, there are Noesis offices in Germany, China, France, USA, and Japan mainly operating as sales and customer support. Additionally, there is one office in Italy where research operations are hosted. In the Figure 2, the different Noesis locations are shown in a map representation.

Figure 2: Noesis worldwide locations

The organizational structure of the company consists of the Sales, HR, Marketing, Research, Development, Customer Support, Product and Finance departments. See in the organizational chart schema in the Figure 3.

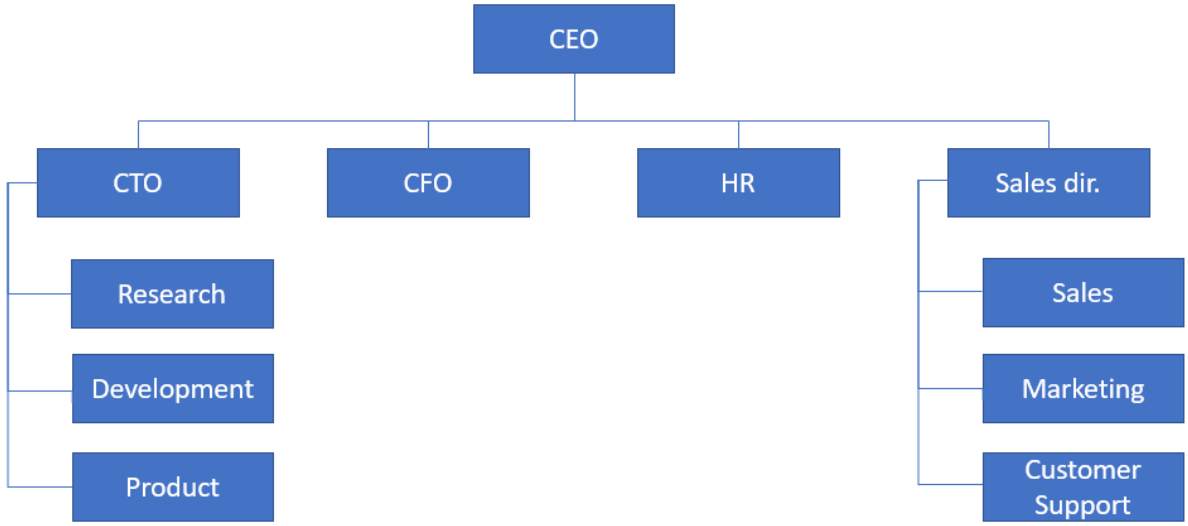

Figure 3: Noesis Organization chart schema

Noesis a small-medium worldwide enterprise that currently staffs 40+ employees in all the departments worldwide in different teams. The top management of the company consists of the CEO, the CTO, the CFO, the HR manager, and the sales director. The middle management of the company consists of the Research, Development, Product and Application Engineering Managers that are reporting to the CTO and the Sales director, respectively.

The Research team is responsible to develop and maintain the core technologies of the company that are usually called the Noesis SDK (software development kit). The products of the company are build based on the Noesis SDK. The development team is responsible for the construction of the end user products and to complete service projects for the customers. The product team is responsible to orchestrate the vision and execution of the product development. The sales team consists of the sales executives with main responsibility to sell the products and the engineering projects. The marketing team is currently not staffing any personnel. Finally, the customer support team is responsible for the pre- and post-sales activities.

Apart from the departments mentioned above, Noesis is collaborating with external partners to perform operations such as sales/distributions and testing. As it is mentioned above, there are Noesis offices in several parts of the world. Noesis is collaborating with external companies that serve as distributors of its products, in the regions that an office does not exist, or in regions that the business intensity is quite high. Consequently, in regions like India, Russia, or Israel, Noesis is not selling directly but through another company that is considered

a Noesis products distributor. The Figure 4 shows the different ways that Noesis is reaching the customers since distributors do not only sell the products but they can also provide post-sale support.

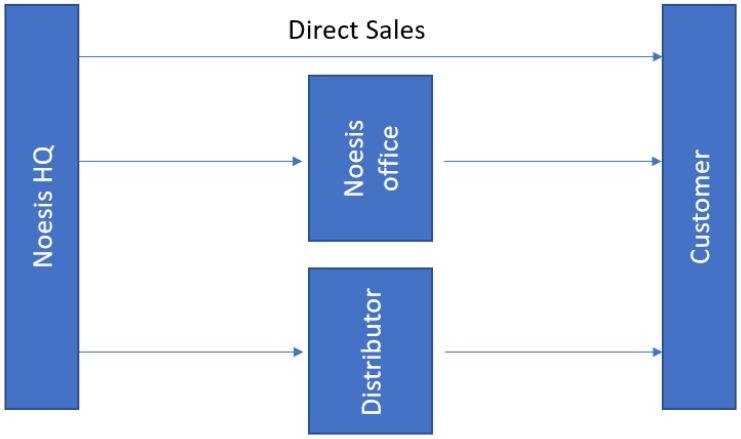

Figure 4: Noesis go-to-customer approach

For product testing, Noesis is collaborating with an external partner that is specialized in software testing. A small testing team is working continuously in collaboration with the product and the development teams of Noesis to ensure the quality standard that are set by Noesis for the products.

Since 2003, when Noesis was founded as a spin off of LMS, there is a single product in its product portfolio. It is called Optimus, and its development started in 1996. Optimus is a Process Integration and Design Optimization (PIDO) software, offering a wide and powerful range of capabilities for Engineering Process Integration, Design Space Exploration, Engineering Optimization and Robustness & Reliability [11]. The technologies that Noesis develops and integrates in Optimus help engineers and designers to capture and automate complex engineering workflows in an intuitive way. This allows engineers to save time from tasks with less impact. Additionally, the design exploration and optimization methods help them to explore a wide spectrum of solutions for the specific engineering problem that is analyzed and calculate optimal solution given the constraints of each problem. Optimus users report design time savings averaging over 30%, while achieving 10% or more design performance improvements[11]. Optimus is a vendor neutral desktop software that provides an open architecture that allows users to couple with any kind of engineering software that are used in several engineering processes.

As it is mentioned, Optimus has an open architecture and that has allowed Noesis to partner with external technology providers to enhance the offering of Optimus. For specific applications, advanced optimization techniques are needed. For that reason, Optimus can couple with 3rd party optimization solutions such as Dakota, eArtius or Divis. Additionally, Optimus openness allows to couple any kind of 3rd party software. It is quite common, that big research institutes, or companies develop their own in-house solutions. It is possible for them to couple their solutions and use them together with Optimus.

Optimus is a licensed software, and it is offered currently with two different models, purchase, and leasing. The purchasing model gives full ownership to the user for the current version of the product. For maintenance and support possibilities, a yearly fee is charged. The leasing model grants to the customer access for one year. In the end of the year, the lease plan needs to be renewed.

As it shown in the Figure 4, Noesis is selling products and services to the customers from the HQ, from the local Noesis offices or through distributors. In the Figure 5 it is shown the revenue for the last 3 years (2017, 2018 and 2019) and an estimation of the 2020 revenue since the final number is not consolidated yet.

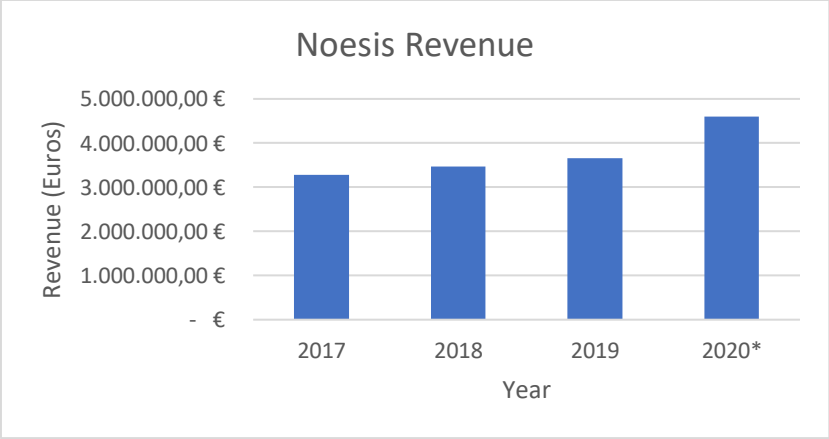

Figure 5: Noesis revenue (2017-2020)*

The data shown in Figure 5 shows that the revenue of the company is growing the last years. It is worth it to mention the growth since 2019 is estimated to 26%. The Figure 6 shows the revenue distribution in the different areas that the company is operating. It is clearly seen that China and Japan are the regions with the highest contribution. Additionally, Germany is

the country that shows a growth potential. The region with the highest business growth historically is China.

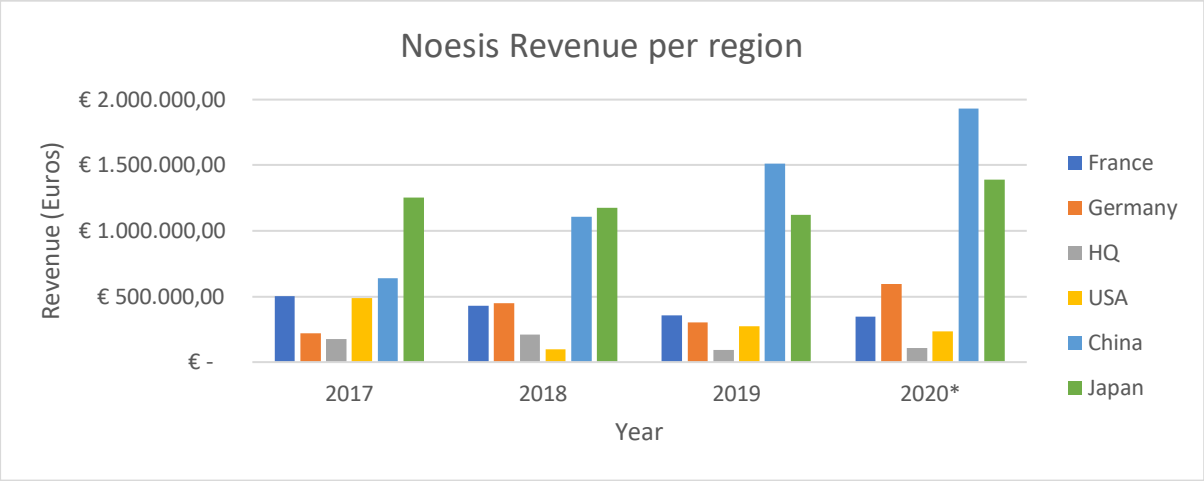

Figure 6: Noesis Revenue per region (2017-2020)*

Even though Noesis portfolio is small offering only one product and service projects, the customers of Noesis are active in various industries. As it is shown in Figure 7 Noesis is active in 16 different industrial sectors. Although, the revenue distribution is not homogeneous as it is expected. For the period of 2017 -2020, the main revenue flow for Noesis is coming from the automotive industry. This includes several types of companies that are active in the design and manufacturing of several car components and the main companies of the automotive industry. It is clearly shown that the revenue coming from the automotive industry is growing in a stable growth rate. In the second place there are customers coming from the aerospace industry. This industry includes manufacturers of airplanes components, aircrafts, helicopters, satellites, etc. Additionally, it seems that the revenue from the customers of the Electronics industry has significantly rise the last years and especially in 2020. The Electronics industry includes the development of electronics, telecommunication, and electric motors.

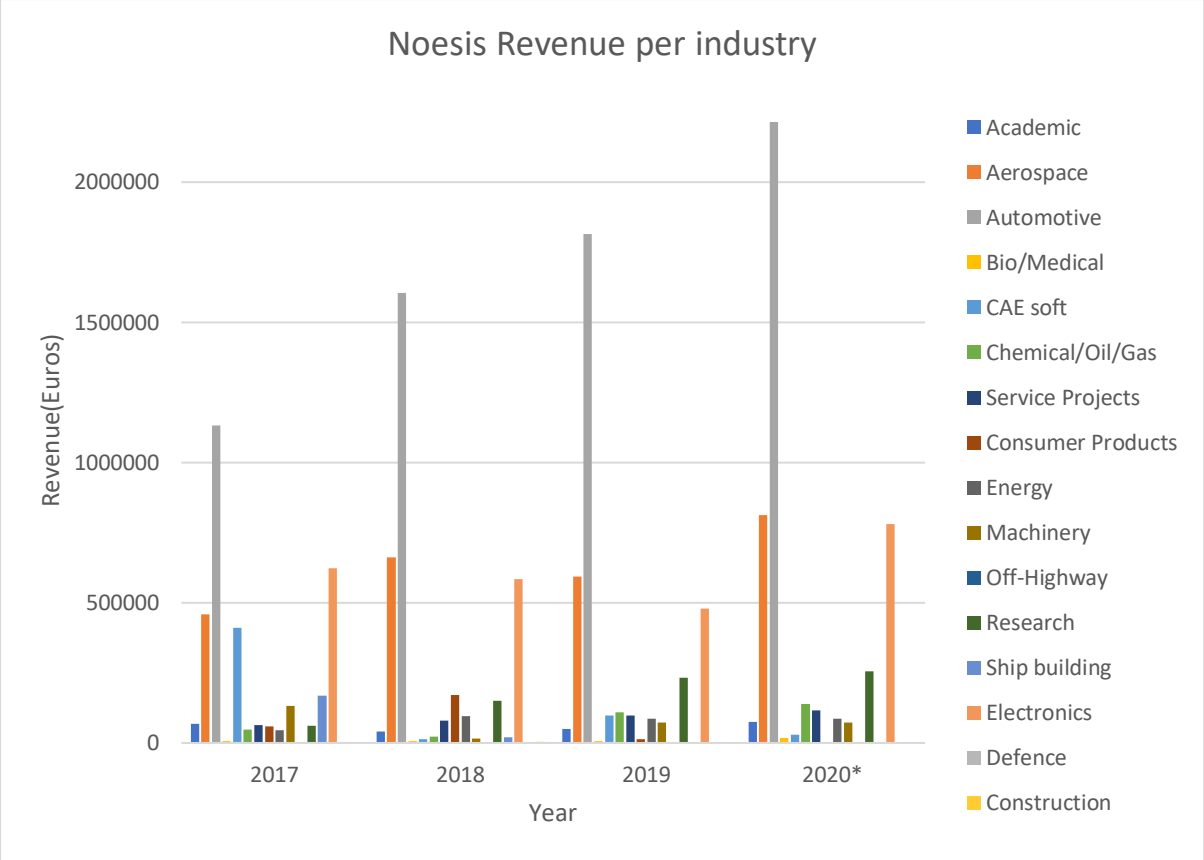

Figure 7:Noesis revenue per industry (2017-2020)*

As it is mentioned above, the revenue of Noesis is based on sales of products (including direct and indirect sales) and from the delivery of service projects that are most of the times custom software implementations for customers that want to use Noesis technology. The Figure 8 shows the Noesis revenue from service projects vs software sales. It can be clearly seen that the yearly total amount from the service projects is quite small compared to the software sales. Even though it is not directly shown in the Figure 8, the joint projects with the customers create a tight connection of the customer to Noesis that leads to more software sales when a service project is successfully delivered.

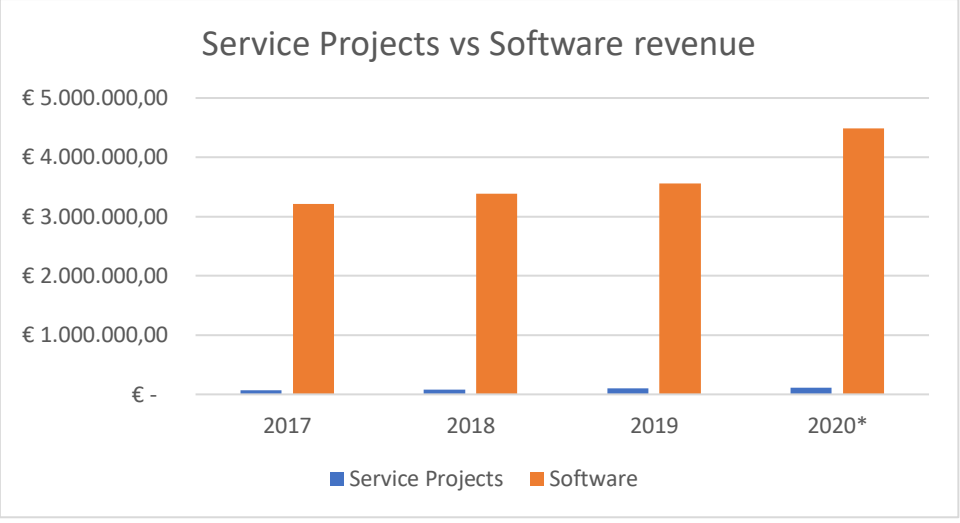

Figure 8:Service Projects vs Software revenue (2017-2020)*

Noesis External environment

The analysis of the external environment of Noesis is fundamental for the further understanding on the conditions that the new marketing plan will be implemented. To complete the analysis, this assignment focuses to study the micro-environment of the company and the macro-environment to give insights for global situation where the company operates in.

Micro-environment analysis

There are several methods to approach the analysis of the microenvironment. One of the most popular methods is the use of the "five forces" that Porter describes in the first chapter of his book Competitive Strategy in 1980.[12] The five forces of Porter seem to shape the structure of the industries, set the rules of competition and the root of profitability within an industry. The five forces of Porter are the threats posed by[13]:

- Competitive rivalry
- Powerful buyers
- Powerful suppliers
- Potential new entrants
- Substitute products

The Figure 9 shows a schematic representation of the model:

Figure 9: The Porter's five forces model[13]

Noesis is active in the global simulation and analysis (S&A) market. S&A is one of the fastest growing segments of the overall product lifecycle management (PLM) market[14]. Apart from its size, the importance of the PLM market is also growing in supporting product and process development in a rapidly changing industrial environment. Even though the global economy is unstable after the crisis of 2009 and the 2020 pandemic crisis, the PLM market continued to grow the last decade. For example, in 2016 the PLM market grew to $41 billion, 5% more than the 2015. The PLM market grew in 2019 for 7.6% to $51.4 billion. The Figure 10 shows the sectors that form the PLM market in 2019 including the market sizes in $ accordingly. The S&A sector that Noesis is active, is one of the biggest segments of the PLM market.

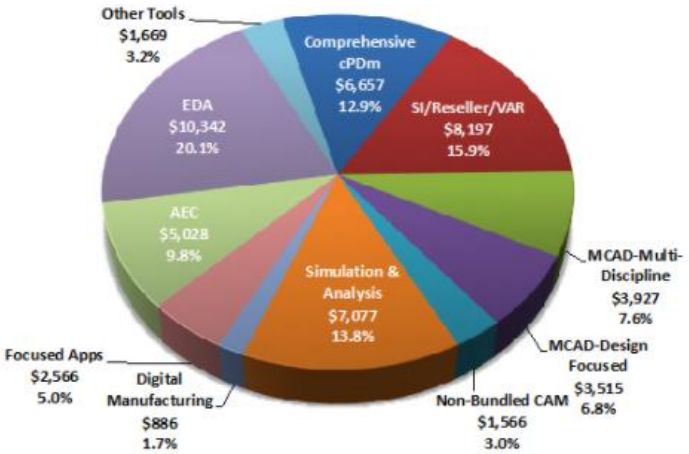

Figure 10: PLM market sectors sizes in $millions (2019)[15]

The Figure 11 shows that PLM budget grew at all industries since 2016. PLM budget is greatest in the automotive sector, fabrications and assembly, electronics, and aerospace. It is clearly lower in the process and utilities. Since the PLM market contains a few sub sections, it is not

clear from the Figure 11, how the S&A growth is in the industries listed. Although a clear trend in specific industries is shown. As it is mentioned during the internal environment analysis, Noesis is active in the Aerospace, Automotive, Electronics, Process/Petro and construction industries.

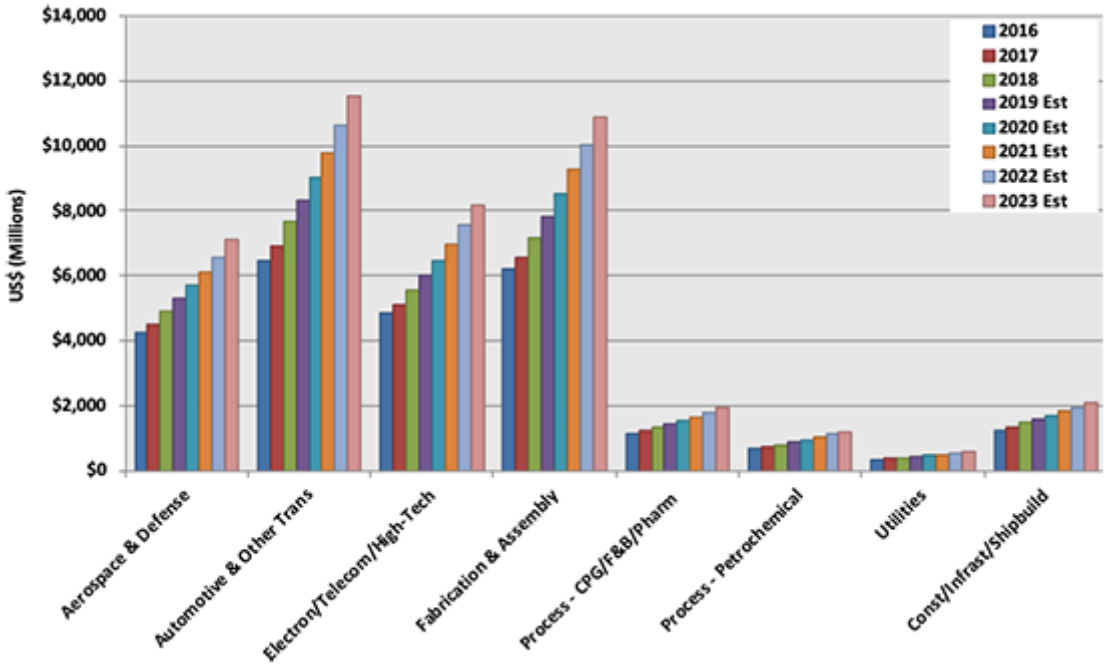

Figure 11:PLM industry sectors and growth estimates(2019)[16]

As it is shown in the Figure 12, in 2018 the S&A revenue grew to $6.5billions which is an increase of almost 15% compared to 2017. It seems that the S&A has a steady growth since 2014 and the predictions show that it will be a rapidly growing sector over the next five years. It will reach around $11Billion in 2023 helping companies to evaluate and optimize multiple design concepts[17].

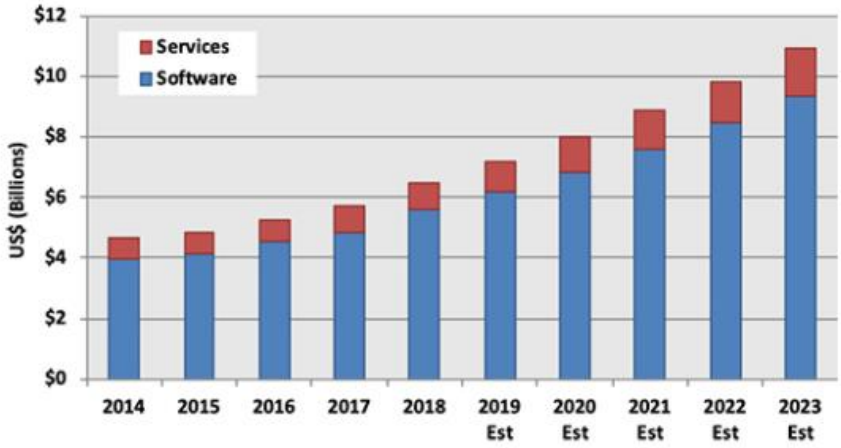

Figure 12: S&A Market history and growth estimates (2019)[17]

The S&A market contains several smaller segments that need to be included in the analysis of this assignment. Some of them are quite large and some of them are not that large, as the one that Noesis belongs to. Some of the large segments of this market are:

- 2D/3D structures, strength, stiffness, and vibration
- Structural fatigue and durability
- Computational Fluid Dynamics (CFD)
- Thermal and heat transfer analysis
- Simulation Process and Data management (SPDM)
- Impact, crash, and safety

Some of the smaller segments of this market are:

- 3D topology and geometry optimization
- Predictive analytics for large volume simulation results as well as
- Empirical data from field operations and controlled tests
- Process orchestration and automation across multiple simulation
- domains and tools
- System synthesis, optimization, DOE, robust design
- Physical testing and empirical data analysis
- Vertical applications by industry (e.g.: engine performance, combustion, powertrain)

The market leaders provide solutions across many of these segments, especially the large ones, but there are also specialists that often have best-in-the-market solutions in a particular segment. These smaller providers continue to develop innovative and game changing S&A technologies that may be too tempting to resist for the larger S&A firms. One of those specialists is Noesis that provides solutions in the 3D geometry optimization, the process orchestration, DOE, and robust design segments currently.

The tools that enable the process improvements (best practice automation and integration of 3rd party tools) and simulation-based decision making (DOE, Surrogate models, and optimization) will continue to have a major impact on how work gets done at industrial companies. An analysis of the competitive landscape for Noesis follows below, considered the market framework set above.

ESTECO is a company founded in Italy, in 1999. Esteco has offices in Italy (HQ), the United States and in India. The company has strengthened the sales channels with a distribution network that is active in more than 9 locations worldwide, including Europe, Japan, and Latin America. In 2019, Esteco's revenue was a bit lower than €12M. Currently more than 110 employees work at Esteco in various departments. The company is currently active in the process automation, DOE, and optimization industry with the legacy product modeFRONTIER. Esteco has introduced a couple of years ago another product, VOLTA, that is a web-based second generation SPDM solution, based on a service-oriented architecture that can be deployed independent of ESTECO's core modeFRONTIER. It provides capabilities for simulation data management, distributed compute execution, optimization-driven design, and simulation data analytics. Esteco gets part of its revenue from engineering services.

Dynardo was a company founded in Germany in 2001. Dynardo had offices in Germany and in Austria. The company was delivering its products through a big distribution channel that is active in more than 15 locations including several locations in Europe, America, Japan, and China. In 2019, Dynardo was acquired by Ansys, one of the biggest players in the S&A industry. Consequently, all sales network of Ansys can distribute the ex-Dynardo's products. The year before the acquisition, Dynardo had a revenue of €8M and around 60 employees. The company was active in the same industry as ESTECO with the legacy product optiSLang. Dynardo gets part of its revenue from engineering services too.

Datadvance is a company founded in Russia in the beginning of 2000. Datadvance has offices in Russia and France. The company has a distribution channel that is focusing mainly on the Asian market with focus in India, China, Japan, Korea, and Taiwan. In 2019, the revenue of Datadvance was close to €4M and currently around 40 employees work at Datadvance. The company is active in the same industry as the previous mentioned with a product called

pSeven. Recently the company has introduced a web-based version of the legacy product called pSeven Enterprise that it provides the same capabilities as pSeven with a different deployment architecture. Datadvance gets part of its revenue from engineering services.

Siemens is a German multinational company founded in 1847 and it currently in many different industries and markets. Siemens is active with many products in the PLM and S&A industry and it is considered as one of the biggest vendors. The company reached a revenue of €87 Billions in 2019. It is not known what the revenue from the market segment of process automation and optimization is. In this market Siemens is active with Heeds that is part of a big family of S&A products called Simcenter. It is not known how many of the employees are assigned for the development and sales of Heeds. It is certain that the global Siemens network can be available.

Dassault systems is a French multinational company founded in 1981 as a spin-off from Dassault Aviation. It is headquartered in France and currently has around 20000 employees. In 2019, reached a revenue of almost €4 Billions from all the markets that is active. Dassault is active with many products in the PLM and S&A market and it is considered as one of the bigger vendors. It is not known what the revenue from the market segment of process automation and optimization is. In this market Dassault is active with Isight that is offered either standalone or as part of a big family of S&A products called Simulia. It is not known how many of the employees are assigned for the development and sales of Isight. It is certain that the global Dassault network can be available.

The vendors mentioned above are the main current competitors of Noesis in the process automation and optimization market segment. Some of them are classified as the “specialists” and some of them are the big vendors of the PLM market. Apart from them, it is quite often that products that are dedicated for the large segments of the S&A market such as CFD, structural analysis or thermal analysis, offer functionalities for DOE and optimization. They are not separate products to be considered as competitors of Noesis product, but pieces of technology integrated to products that are dedicated for other segments of the S&A market.

All the products and solutions mentioned above are offered through business models defined by the owner company. There are also other solutions that are offered in the open-source community focusing mainly on the optimization and DOE and not in the process automation. Some examples are the optiY, the Piano, the Nexus. Due to the complexity of the technology that is needed for this market, it was not that often in the past to have reliable open-source solutions. The last years, though it seems that the visibility of those products is increased from the big manufacturers. A disadvantage that is often mentioned is that even if the open-source products have a large community to develop and maintain them, the pre- and post-sales support is still the main reason for the big manufacturers to not select them as a solution to be used in their processes.

The bargaining power of the buyers can be classified as medium for this market. The customers are usually big manufacturing companies that can buy a few or a big number of licenses. Consequently, it is possible that many users will be using the product in one company. The S&A market is relatively big but the segment that Noesis operates is relatively small. Practically that means that the number of customers (accounts) is not that big. For that reason, the power of the customers is increasing. On top of that it is mentioned above that several big software vendors often offer products or functionalities as part of their suites. It is certain that each big manufacturer will have a suite from one of the big vendors. Consequently, the risk to switch from one solution to another is increasing. On the other hand, due to the complexity of the technology, it is often observed that it is a time consuming and uncertain task to switch from one provider to another without risking the output quality.

The bargaining power of the suppliers for this market can be classified as low. The companies in this sector are producing digital products which has fundamental differences from the physical products that require raw materials etc. For example, an airline company has strong dependency on the aircraft provider itself and the fuels. Those two suppliers can get substantial bargaining power on the prices that they charge. In the case of the digital products the suppliers are either technology suppliers or manpower suppliers for the development teams. Although, due to the complexity of the technology the companies develop themselves the core technology and it is quite rare to depend on an external supplier for the fundamentals. Nowadays, it is relatively easy to find skilled people with programming

knowledge to create an external development team. Although, due to the complexity of the products, most of the companies in this market they form internal development teams and they do not rely on external suppliers for the main development and maintenance of the products.

The threat for new entrants can be estimated as low. As it is presented before in the competition analysis in the S&A market there are software vendors that offer solutions for the different market segments that are presented before. One of them is the process automation, doe, and optimization that Noesis is active. It seems that it would be quite difficult for a new company to enter the S&A market and compete directly with the big vendors since they already have the technology, the experience, the network, and the market share to compete sufficiently with every new entry. Additionally, the technology that is used in the S&A market in general is advanced. It would require years of research and investments for a new entrant to develop a solution that could have potential on this market.

In the analysis above, paid, and open-source products are considered competitive product for the process automation and optimization market segment. A threat for substitute products can be considered when the big manufacturers develop solutions in-house that substitute the functionality that it is offered by the software vendors mentioned above. The manufacturers are usually very big organizations, and it is possible to have a small software development department in it. In that case, this department can develop a solution that is tailored to the exact needs of the business. This is not a product and it will not be sold externally, but it is possible to substitute the functionality that is offered as part of the products that are mentioned above.

Macro-environment analysis

For the analysis of the macro-environment a PEST analysis will be performed. This includes an investigation of the political, economical, social, and technological trends. This assignment is not focusing on a specific country or area, thus the main trends around the globe are analyzed.

Political trends

The businesses that are operating in developed markets faced a complex political landscape in 2020. This year was a tipping point for the international politics. The recent years,

globalization has created several opportunities for existing and new businesses, it reduced poverty globally and ensured peace for billions of people. Recently the China and US are decoupled technologically, and the economy is now breaking. The developed countries are now polarized. Additionally, climate change topics matters a lot. The global political risk has reached a high limit in 2020 and it will persist in the following year. A combination of the COVID-19 pandemic, trade wars, climate change and other factors show that the performance of the companies, markets and economies worldwide will be impacted by the political decisions that have taken in 2020 or they are announced for 2021.

The result on the US elections is cleared out recently but it seems that the result has already caused some irregularities. It is expected that the new US president, Biden, will realign the US policy in 2021. He has already stated that he will focus on strengthening industrial and environmental policies. The corporates should expect that the production and the supply chains in strategic sectors will shift more to the US economy. Additionally, the so called "green" industries will face growth and several investment opportunities.[18]

China and US will continue to try to setup a trade relationship considered the trade relationship, the technological competition, and several industrial policies. The decoupling of US and China has started from the technological sectors (e.g.: semiconductors, 5G) but it seems that it will become broader to other activities creating a permanent geopolitical crisis between the two countries. On the other hand, Europe will keep investing on an effort for strategic autonomy. For that reason, new trade, investment, and industrial policies will be pushed towards the rest of the world. Additionally, it is expected that the tensions between Russia and west countries will continue while the role of Russia in the middle East is getting stronger. Finally, the current relationship of EU and UK seems to be risky since all the political and economic issues are not addressed yet.[19]

After almost 1 year that the world is suffering from the COVID-19 pandemic, there is no doubt that one of the top political risks for next year is related to that. In general pandemics are raising security, leadership, collaboration, and competition issues. As an example, inequalities to the access to healthcare are observed in several countries. This pandemic is much more than a public health crisis since it has become a global scale political event.

Economical trends

In 2020 the global economy faced dramatic difficulties. In H1 of 2020, the economy had entered severe depths due to the big worldwide lockdown. The last months of 2020 situation was slightly better even though the pandemic continues to spread worldwide. Many countries had reopened and resumed economical activities while others are applying partial lockdowns to protect the vulnerable populations. On the other had the recovery of the economy in China was much faster than expected, but the global economy does not seem to return in the pre-pandemic situation[20].

It seems that the global growth for 2020 it will be around -4%, which is less severe than the initial forecasts. The global growth is projected to 4% for 2021 with wide negative output gaps and increased unemployment rates for both advanced and emerging market economies. After the 2021, the global growth it is expected to slow down around 3% in the medium term. This is limited compared to the 2020-2025 projection before the pandemic. Assuming that the social crisis continue in 2021, but it will fade out progressively with the vaccination strategies, the economies will experience the need for structural changes. [21]

Figure 13: Global GDP growth forecast[21]

The COVID-19 will have huge impacts over the next 12-18 months for the PLM market too. It is expected that the global PLM market growth in 2020 will be 2.4% growth in 2020. By comparison, the global PLM market had a negative growth of 9.6% in 2009 due to the impact

of the great recession crisis. This means that while PLM investments are suffering from the epidemic, it is estimated that PLM market will keep growing in 2020. In addition to the impact on market trends, the COVID-19 pandemic will also have an impact on PLM technology changes. For example, the servitization of the products, the cloud infrastructures and the remote business activities seems to become more a reality than a trend.[15]

Social trends

Fifteen years ago, the United Nations have warned that inequality could be a factor that affects the achievement of the internationally agreed goals. Although today it seems that economic growth worldwide and the improvements over the last decades have failed to close the big gaps within and across countries. Currently there are trends, such as technological innovation, climate change, urbanization and international migration that create an impact in inequality. The rapid technological change can be a factor that results to economic growth by offering new challenges in various sectors such as healthcare, education etc. but it can also cause wage inequality and displacement of labor force. Additionally, the impact of the climate change is a serious topic worldwide, but it seems that the poorest countries are suffering a lot. Urbanization offers diverse opportunities, while cities can have people in total poverty or wealth trying to balance to live together. This is growing higher levels of inequality within the same system. Finally, the international migration gives the opportunity to many people to look for new opportunities but it always includes the risk of bad conditions that those groups can face. [22]

The COVID-19 pandemic has affected all the population groups and most of the groups that are in vulnerable situation, such as the people living in poverty, elder people, persons with disabilities and young people. It seems that the health and economic impact of the virus is not proportional to the financial situation. For example, homeless people are more exposed to the virus since they are unable to find a safe place to stay. People that are refuges and/or immigrants also suffer due to the pandemic and due to the economical crisis fewer employment and opportunities appear. Currently the health crisis is not currently under control and it seems that if the social crisis that will be created due to the situation is not addressed, inequality, exclusion and discrimination will be increased in medium and long term.

Technological trends

Established and new technologies have helped the businesses for decades to implement their digital transformation. The 2020 COVID-19 pandemic has shown to everyone the importance of technologies that we thought that are more developed that what they are and vice versa. There are several technological trends and advancements, this section though will focus on technological trends that are of interest for the multi-domain, multi-physics, and multiscale systems-level virtual prototyping and performance. These global industry trends include:

- Smart, connected products enabled by the Internet of Things (IoT) and Industry 4.0.
- Electrification and light-weighting of vehicles and mobility systems.
- Machine learning enabled by analytics and artificial intelligence.
- Mass customization using formalized product line engineering (PLE) approaches with embedded software features being a key new product differentiator for end user functionality across all industries.
- New manufacturing methods that are designed to meet specific customer
- requirements (e.g., additive manufacturing)
- New generative design processes that leverage design, simulation, and manufacturing technologies to create optimized product definitions.
- Products as a Service, i.e., the ongoing utility business model where the consumer pays for the benefits and use of a product owned by the manufacturer or other third-party service organization and that may be upgraded and/or re-configured multiple times throughout the lifecycle.
- The digitalization of all enterprise functions including the “platformization” of product development creating open standards for engineering data and model interoperability and new Cloud/Software-as-a-Service delivery models.
- Rapid movement toward the digital thread/digital twin paradigm to connect product data and information throughout all domains and ecosystems, throughout the lifecycle, to enable product innovation, quality, sustainability, and profitability.

The global market leaders across several industries are expanding the use of virtual prototyping and simulation to deal more efficiently with rapidly changing market trends and end customer requirements. In the S&A market, the traditional multi-physics mechanical analysis software solutions are extended to work with other domains as electronics, controls, virtual reality, automation etc. Additionally, those systems have become more open and they are converted towards web-based architectures and cloud/SaaS software delivery models that are quite mature nowadays.

Primary research

Part of this assignment is the orchestration and the execution of market research with primary data collection. The data that is collected is afterwards analyzed and used to create the marketing plan together with the analysis above.

The research that is performed is a quantitative research with end goal to reveal details of the simulation and analysis market with focus on the virtual product development and the digital transformation. One of the goals is to reveal the challenges that are faced in different industries and how those challenges are related with the industries in different regions. Additionally, the familiarity with some well-known technologies and the perception of those technologies is also part of the interest. Finally, the level of the digital transformation and "platformization" for the different industries is interesting for this study.

The plan was to perform a primary data research in the regions that Noesis has business activity. For that reason, the research was communicated to the participants through the Noesis distributors and Noesis offices in Europe, USA, Canada, China, Japan, Russia, and Israel. It was requested that each company that is Noesis distributor sends the market survey to emailing lists of customers that are active in the simulation and analysis market sector. The exact number of recipients is not known since the distributors of Noesis cannot publish details of the mailing lists that they are using. It is also assumed that some of the recipients that corresponded to the market survey can be existing Noesis customers. Thus, this is a market research that is using a non-probability sampling method, where convenience sampling was selected.

The market survey was performed from 21 December 2020 to 8 January 2021. After the latter date, the market survey was not available anymore. Since this market survey was targeting a niche audience, the survey was not available in any social media and it was not forwarded to family and friends. The initial goal was to collect 70 survey results from the various regions mentioned above. Finally, 49 people responded to the survey and their answers were recorded. It is not possible to calculate the conversion rate for this survey, since the number of the initial recipients is not known.

Data collection is the procedure of collecting, measuring and analyzing the insights that are collected with validated research techniques. Ensuring that a statistical analysis can be

performed after the end of the survey, is the main objective while planning a market survey. This was an online market survey, where all participants were reached by email and an internet connection was needed to get access to the survey and submit the answers. The tool that was used to organize the market survey was a structured questionnaire in Google Sheets. In the beginning of the survey the introduction text was informing the participants that this market survey is intended for academic purposes and ensures for the confidentiality of the survey. The questionnaire was validated with the supervisor of the master thesis and feedback was also collected from the Sales Director of Noesis.

The questionnaire has 3 main sections. The first section investigates the current use of simulation and analysis tools in the organization of the participant. Additionally, this section investigates the main challenges that this organization is facing. In the last part of this section the attendees are asked to evaluate some technologies that can address the challenges that are facing in their organization. This section contains mix questions, checklist multiple choice and Likert scale multiple choice questions. The second section investigates the degree of the digital transformation of the organization related to simulation and analysis. The questions are related to the use of simulation and analysis resources in-premise or in cloud, the storage of simulation data in cloud or in premise and the use of software platform for internal and external communication. This section contains mix questions, multiple choice, and Likert scale multiple choice questions. The last section refers to general question for the type of the industry, the size and the location of the organization and the role and the education of the participant.

As it is mentioned above, the participants of the survey are customers of the distributors of Noesis that are active in the simulation and analysis market segment too. The Figure 14 highlights that most of the attendees of the survey are active in the Automotive and Aerospace segments. This is an expected result. It is worth to mention that a significant amount of the participants is active in the Electronics market area (24%). Finally, less participants are active in the Pharma/Medical industry. This does not give a direct indication of the penetration of simulation and analysis technologies in the pharma/medical since it depends a lot on the population that received the survey and on the current business focus of the Noesis distributors.

After the collection of the data, the analysis of it follows. The arithmetic mean, know as the average, is used to determine the overall trend of the dataset and to provide a rapid snapshot of the survey's results. Additionally the standard deviation (STD) reveals the spread of the data around the mean. When standard deviation is high, then the spread of the data is wide around the mean. Additionally, different plots (e.g: pie chart or bar chart) are used to visualize the data that is collected from the survey.

Additionally, a Chi-Square test of independence determines if there is a dependency between categorical variables. It is a nonparametric test that is also known as the Chi-Square Test of Association. This test creates a contingency table to analyze the dataset. A contingency table (also known as cross-tabulation*)*, classifies the data according to two categorical variables. The categories for one variable appear in the rows, and the categories for the other variable appear in columns. Each variable must have two or more categories[23]. There are some requirements that the dataset needs to meet in order the Chi-Square test to be suitable. The variables should be categorical, each variable should include two or more categories, the observations should be independent and the sample size should be large. This survey has 49 responses which is not a large sample size and this is a major limitation for the interpretation of the results of this test. The results are obtained from a Python script where the pandas and scipy libraries are used to obtain the Chi-Square test results.

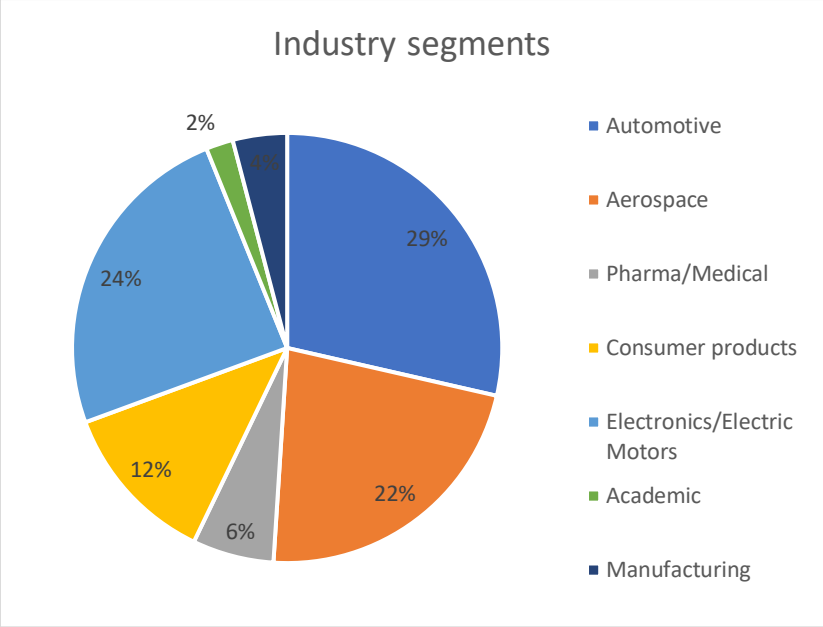

Figure 14: Industry segments of the market survey

The Table 1 demonstrates the correlation between the location where the enterprise is located and the markets segments of interest. Currently it seems that in Europe the automotive industry is using mostly simulation and analysis tools, the Aerospace industry in USA, Electronics and Aerospace in China and Automotive and Electronics in Japan. The data shown in Table 1 and in Figure 14 will contribute to the further development of the marketing plan.

Table 1:Correlation between location of HQ and market segment

	Europe	USA	China	Japan	Other
Automotive	**54%**	10%	13%	**40%**	100%
Aerospace	15%	**40%**	**27%**	0%	0%
Pharma/Medical	8%	20%	0%	0%	0%
Consumer products	8%	10%	13%	20%	0%
Electronics/Electric Motors	15%	20%	**27%**	**40%**	0%
Academic	0%	0%	7%	0%	0%
Manufacturing	0%	0%	13%	0%	0%
Total	100%	100%	100%	100%	100%

The simulation and analysis software tools are quite complex and are highly specialized. The selection of the appropriate tool and the correct type of analysis depends highly on the type of product that each enterprise develops. The Figure 15 shows that various types of simulation have been selected by the participants of the survey. It is expected that while

simulation and analysis techniques penetrate in the market, more types will be developed. This is an indication that Noesis needs to keep collaborating with the 3rd party software vendors that are the developers of the simulation and analysis tools. This is done efficiently until today and needs to be continued in the future.

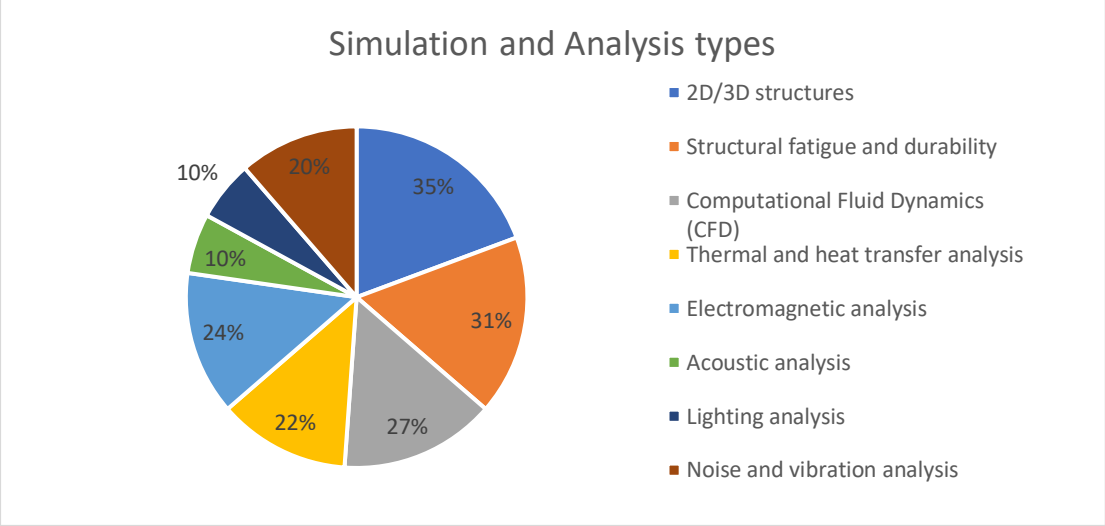

Figure 15:Simulation and analysis types

As it is mentioned in the analysis of the external micro-environments, there are a few market leaders that are offering a wide product portfolio for the global simulation and analysis market and even broader in the PLM market. The Figure 16 indicates that currently most of the organizations that are performing simulation and analysis tasks have not selected a single software vendor as a provider of those tools. That outcome can be explained either historically, where the big vendors did not have such a wide product coverage or it is due to the highly specialized products that are offered from smaller vendors, such as Noesis, that encapsulate more advanced capabilities compared to the solutions included in the platforms of the big vendors.

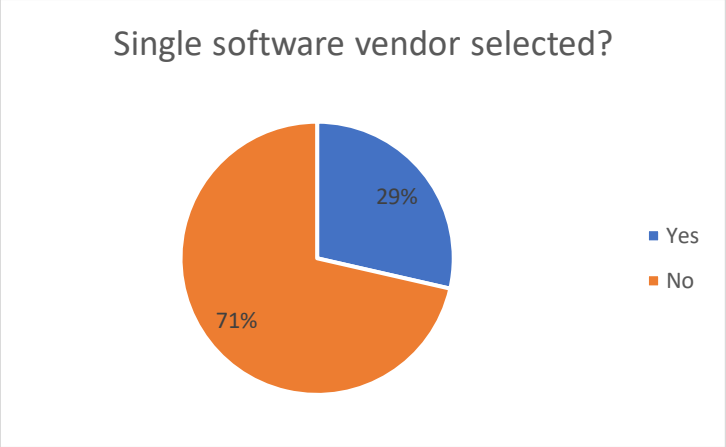

Figure 16:Single vs Multiple software vendors

The Figure 17 indicates the challenges that are faced in the simulation and analysis industry. Among others, the five most important challenges that are identified were selected for this survey. The wide availability and usage of the simulation and analysis software tools to support justified and validated engineering decisions, shortly called as democratization of simulation, is the biggest challenge that is faced in the market currently (m:3.73, std:1.19).

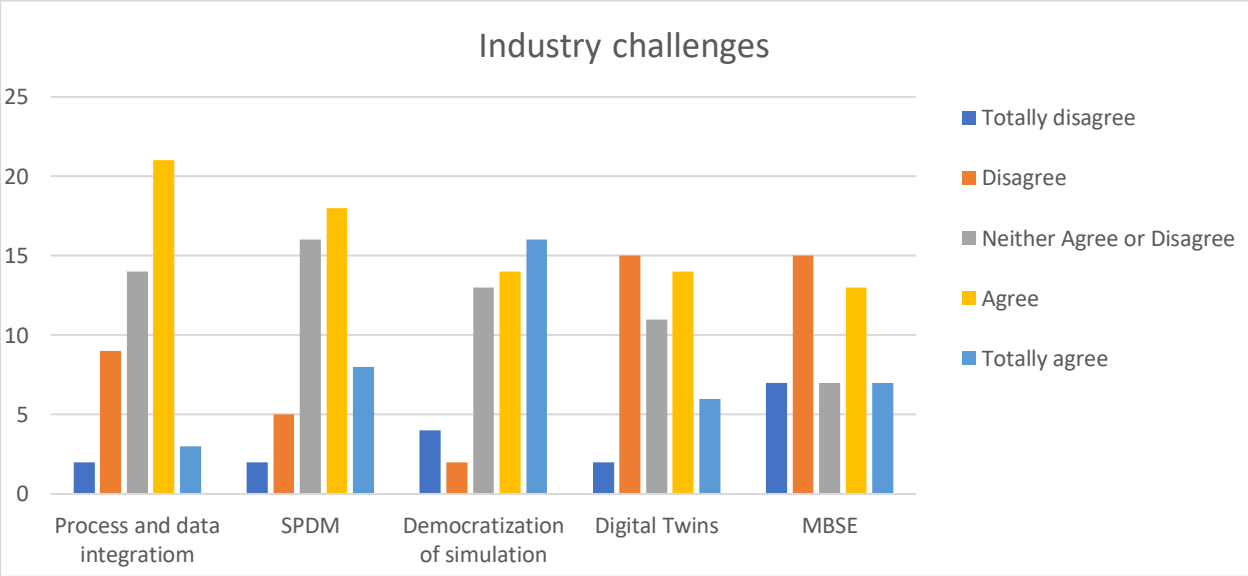

Figure 17: Industry challenges

Slightly lower than this is the need of the market to manage and reuse efficiently the simulation data that are produced during the virtual product development (m:3.51, std:1.01). The two challenges that are identified are complementary since the poor management and storing of the simulation data prevents the wider and efficient use of the simulation tools and techniques from a bigger audience within the organizations. Additionally, it is observed that MBSE and digital twins score low, which is an indication that most organizations are not yet

absorbing such big structural and operational changes. Although, the difference among the five challenges that are studied are not that high to extract safe conclusions.

Table 2:Mean and STD values of the industry challenges

	Mean	STD
Process and data integration	3,28	0,96
SPDM	3,51	1,01
Democratization of simulation	3,73	1,19
Digital Twins	3,14	1,11
MBSE	2,96	1,30

The Figure 18 highlights the different technologies that are popular in the simulation and analysis market and especially in the wider segment that Noesis is active. The participants of the survey evaluated how five of those technologies can help the to address challenges that they face with their simulation tasks. The integration and automation of the several simulation steps that are included in an engineering process is the technology that is selected from this survey as the most popular to address challenges (m:3.71 std:1.09). After that the optimization methodologies seems to be a technology that is needed for the participants in the simulation and analysis industry (m:3.63 std:1.16). An interesting fact is that the data analytics and visualization technologies is the technology with the lowest mean value, although it has scored quite high considered that those technologies are not popular when performing simulation and analysis tasks.

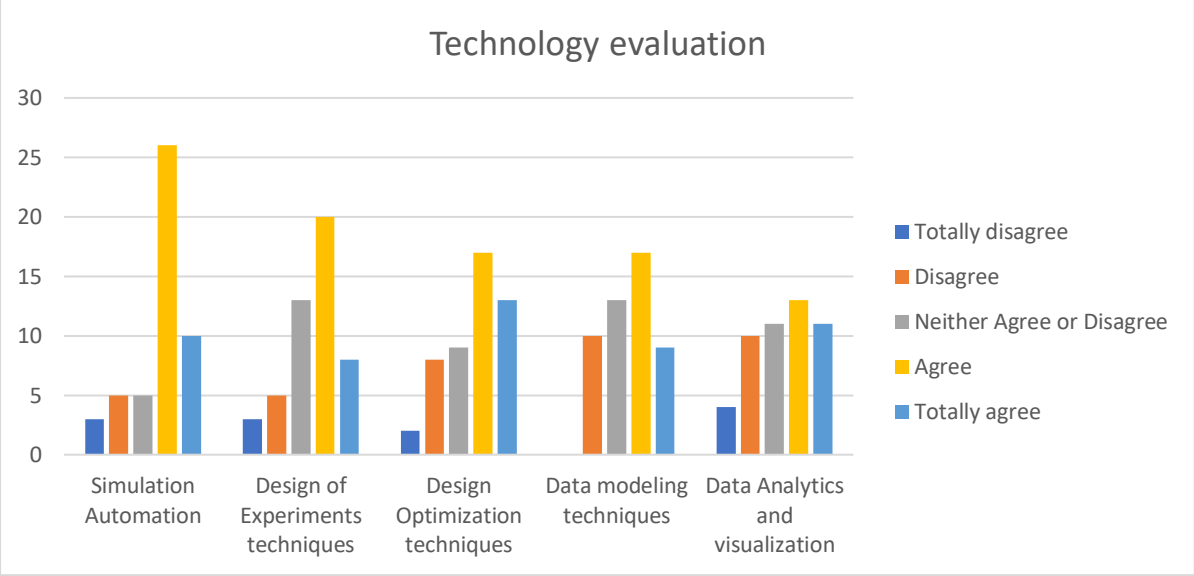

Figure 18: Industry technology evaluation

Table 3:Mean and STD values of the industry technological evaluation

	Mean	STD
Simulation Automation	3,71	1,09
Design of Experiments techniques	3,51	1,07
Design Optimization techniques	3,63	1,16
Data modelling techniques	3,51	1,01
Data Analytics and visualization	3,35	1,25

Last question for the first section of the questionnaire is related to the way that people are informed for new technologies and products that are available in the industry segment of their interest.

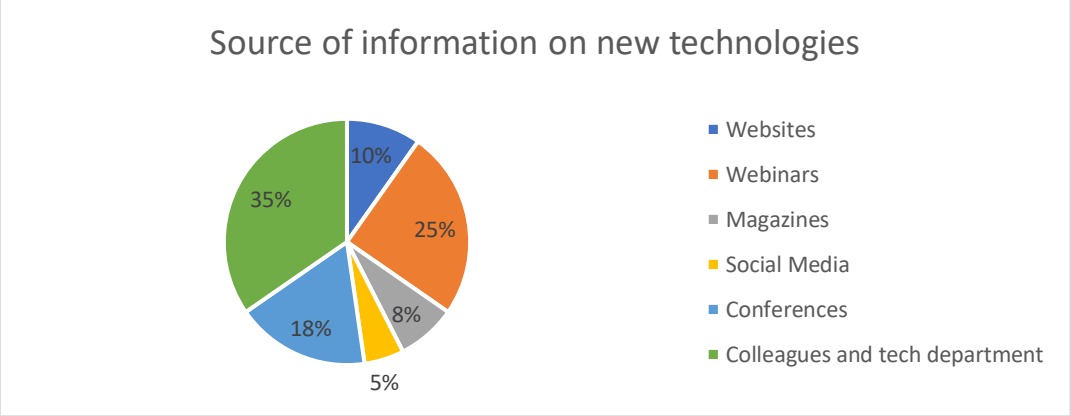

Figure 19:Source of information for new technologies

The Figure 19, shows that most of the people is informed internally, from colleagues or the technical department. Additionally, webinars and conferences are also a major source of information in the field. This graph will be helpful when creating the promotion strategy for the current marketing plan.

Following the analysis of the data for the virtual product development, the digital transformation of the enterprises is studied. The first fact that is of interest is the use of platforms to unify access on the engineering simulation tools, data and to collaborate in a controlled environment externally and internally.

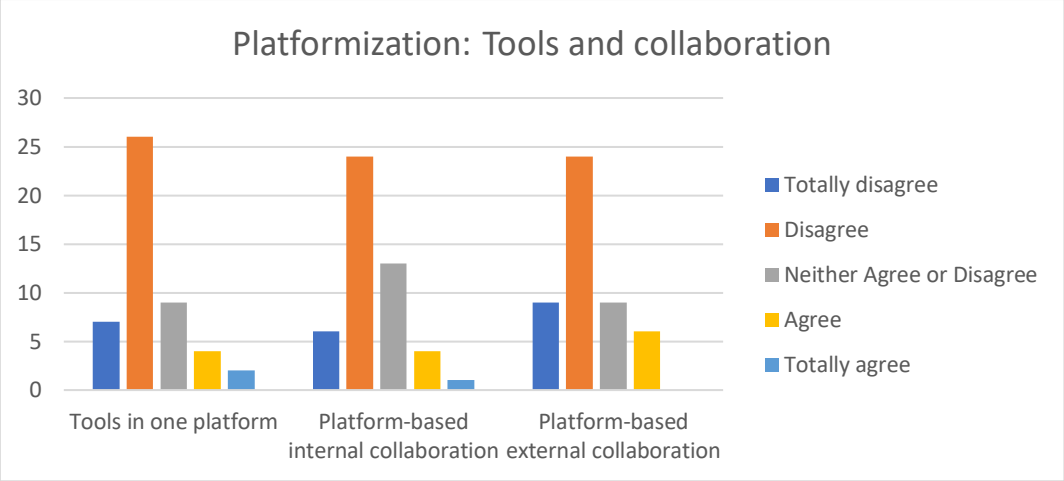

Figure 20:"Platformization" of the simulation tools and the collaboration

Even though several of the big vendors already provide platforms that integrated all the required functionalities (e.g.: simulation tools, collaboration, process management, product lifecycle etc.), it seems that the platforms are not selected from the industry until now. The Figure 20 and the Table 4 highlight that majority of the organizations did not use tools in platforms yet (m:2.33 and std:0.96). The Figure 16 shows that worldwide the industries are not selecting a single vendor for the simulation and analysis tools. Consequently, it can be explained the fact that the platforms of the big vendors are not selected, since they cannot support the migration of tools from different manufacturers.

Table 4: Mean and STD values of the "platformization" in the simulation and analysis industry

	Mean	STD
Tools in one platform	2,33	0,96
Platform-based internal collaboration	2,38	0,88
Platform-based external collaboration	2,25	0,90

Most of this market research participants seem to work in SME or large organizations (44% of those companies employ 501- 5000 people and 19% of them more than 5000). Additionally, the attendees of the survey work in departments with many employees (37% in a team with 21-50 people, 22% in a team of 51-100 people) and the need of collaboration maximized because of the complexity of the tasks and the tools. The situation can become more complex when collaboration is extended to external partners or OEMS, especially when the exchange of data, requirements etc. is needed.

During the analysis of the external macro environment, two complementary technological trends are identified, the cloud solutions and the software-as-a-service that will affect many technological and non-technological industries. Last part of this market survey is to investigate the current situation in the simulation and analysis market segment and reveal the use of cloud and SaaS.

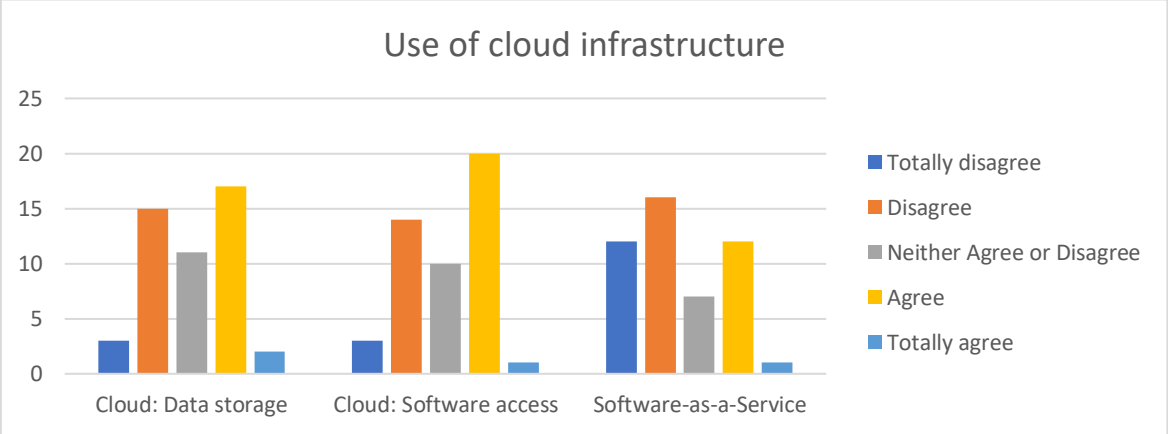

Figure 21:Use of the cloud infrastructure

The Figure 21 and the Table 5 show that the users do not show clearly if the industries are using the cloud technologies to store and reuse simulation data and access software that is only available in a cloud platform. The mean of those two categories is close to 3.00 that does not give an accurate indication. Additionally, it is clearly seen that the SaaS products scored quite low since it seems that the companies are not massively investing on that business model.

Table 5:Mean and STD values for the use of the cloud infrastructure

	Mean	STD
Cloud: Data storage	3,00	1,04
Cloud: Software access	3,04	1,02
Software-as-a-Service	2,46	1,17

The survey that was performed was covering many different regions where national regulations, culture and other factors play role on the way that the companies operate. For

that reason, a further analysis is done to identify the use of cloud technologies in different regions.

Table 6:Mean values for the use of the cloud infrastructure per region

	Europe (mean)	USA (mean)	China (mean)	Japan (mean)
Cloud: Data storage	2,87	3,80	2,50	2,88
Cloud: Software access	2,87	3,70	2,50	3,25
Software-as-a-Service	2,47	3,30	1,69	2,63

The Table 6 shows that the US companies are going faster towards SaaS and cloud solutions, compared to China that is not adopting the new technological trends on the topic yet. Like China, Europe does not see to move that fast in that direction. On the other hand, Japanese companies start to use software tools in the cloud providers but without adopting the business model of the SaaS, which is interpreted that they still purchase or lease software licenses. Finally, it seems that 60% of the employees of the simulation and analysis industry, did not have sufficient access to software licenses while teleworking in 2020. This may change the trend that is observed in Table 6 soon, and companies in Europe and China start to consider adopting the new cloud and SaaS technologies. This topic needs to be investigated further again in a future period.

To investigate if there are dependencies between the several variables that are used for this market survey, a table is created that highlights the p-values between all the variables of the survey. The significance level that is selected is α=0.05. Consequently, a p-value lower or equal than α indicates that the two variables are associated. The Figure 22 shows marked in green all the dependencies that occurred by applying the assumption mentioned above.

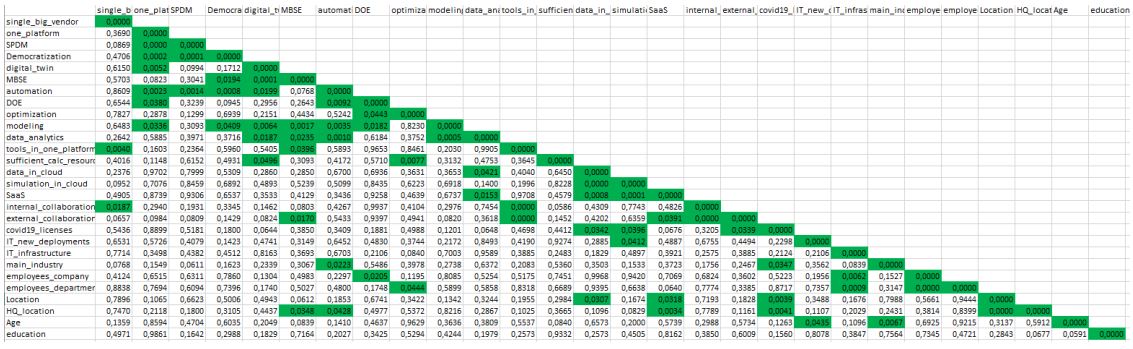

Figure 22: An overview of the Chi-Square test results

Out of all the dependencies that are found from the Chi-Square test, it is interesting for this analysis to focus on the relationship between the challenges that the industries are facing and the available technologies. The Table 7 below shows the dependencies that have identified between the four challenges that the industries are facing and the main core technologies that Noesis is offering.

Table 7: p-values for a subset of variables (challenges vs technologies)

	SPDM	Democratization	digital_twins	MBSE
automation	0,0014	0,0008	0,0599	0,0768
DOE	0,3239	0,0945	0,2956	0,2643
optimization	0,1299	0,6939	0,2151	0,4434
modeling	0,3093	0,0409	0,0064	0,0017
data_analytics	0,3971	0,3716	0,0187	0,0235

According to the Table 7, there is a strong dependency between the SPDM challenge and automation (X^2=17.65, df=4, p=0.00144) and Democratization of simulation challenge and the technology of process automation(X^2=18.98, df=4, p=0.00079) that Noesis offers. The management of the processes and the data produced by simulation often requires automation either to establish the process or to manage the data that are produced by this process. Same applies for the democratization of the simulation, where complicated processes are offered for use to users that are not experts in the field. A sophisticated framework that will deal with the complexity and hide it from the user is needed. Noesis has developed in the past such an automation framework.

Additionally, it seems that there is a dependency between the Digital Twins challenge and the modeling (X^2=14.29, df=4, p=0.0064) and data analytics (X^2=11.83, df=4, p=0.0187) technologies that Noesis can offer. Digital twins are virtual replicas of physical devices. When a twin is available, users can run virtual simulations to predict the behavior of the actual device. Often the twins are constructed in a way to receive data from sensors, which is gathering data from the real physical device. This allows the twin to replicate the behavior of the physical object in real time and offer insights about its performance or potential problems. To achieve that advance data analytics methodologies and modeling techniques are needed in order to build a high performant twin. Noesis is offering those technologies.

Finally, it seems that optimization and DOE is does not currently correlate to any of the challenges of the industry. Even though design optimization was initially developed as the core technology of Noesis 20+ years ago, currently do not need to contribute as the main technology that can address an industrial challenge. This does not imply that the technology is useless, it just indicates that it will not be a key player to address the main industrial challenges.

The analysis above focuses on the global results retrieved from the external secondary analysis and from the analysis of the primary data. It is clearly shown that the several industries of the simulation and analysis market and the needs of the several regions are not homogeneous. This assignment is going to propose a general marketing plan, and it is recommended to the management of Noesis to perform further investigation to the regional markets with questionnaires that are tailored in the local language (e.g.: Chinese) and special characteristics of each region. Combining all the data that will be collected with the current analysis, will result to a more robust plan that can define better the actions per industry or region.

Additionally, the current marketing plan it is conducted during the covid19 pandemic, while the situation in the industry is fragile. It is recommended, that Noesis will perform a follow-up market survey later to evaluate the changes in the market. Finally, due to the complexity of the S&A market it is recommended that Noesis will collaborate with a dedicated market research partner to get reports about the S&A market. The current survey with 49 questionnaires has certain limitations that are mentioned in the beginning of this section.

Noesis SWOT Analysis

The SWOT Analysis is an old concept associated with the strategic planning. For this reason, it has been identified and accepted as one of the main elements of the strategic planning process. To perform a SWOT analysis, it is usual to list the strengths, weaknesses, opportunities and threats on the same page [24]. This is done by segmenting one page into four squares, each for the elements mentioned above and entering strengths and weaknesses in the top squares. Opportunities and Threats in the bottom squares as shown in Figure 23.

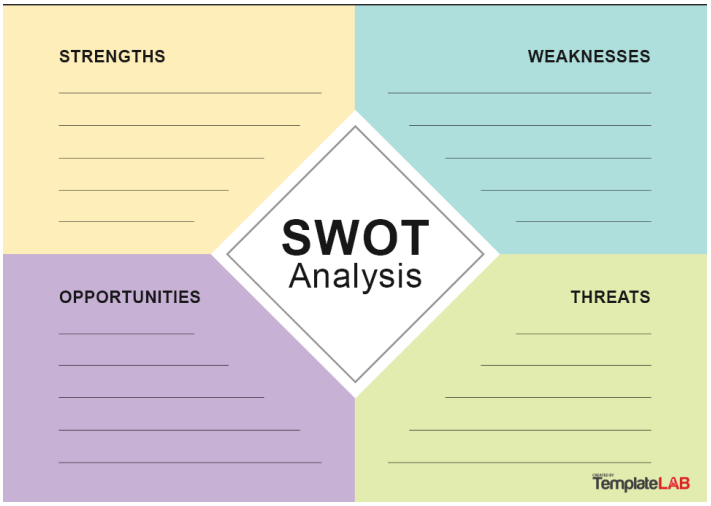

Figure 23: The SWOT Analysis template[25]

The top squares refer to the elements of the internal environment and the bottom squares refer to the external environment. Depending on the scope of the plan that is carried out, several SWOT analyses are performed, e.g., for competitors, products, market segments etc. For this assignment, the SWOT analysis will be performed on a corporate level and the elements will be listed below separately due to page space restrictions.

The **strengths** of Noesis are listed below:

- Optimus is an industry leading software in the field of Process Integration and Design Optimization
- Noesis team has a high technical expertise
- Responsiveness of Noesis teams to customer requests, support cases, etc. is quite high in absolute numbers (e.g.: each technical support question is answered within 24h)
- Access to a bigger business network as a subsidiary company of Cybernet group
- Global presence with offices and distributors in important countries for Noesis business
- Supporting customers in a flexible and agile way. Like the one that company operates.
- Good reputation across the years that the company is present in the industry

The **weaknesses** of Noesis are listed below:

- The portfolio of Noesis is limited with one major product in the market. Other technologies are under development but without clear positioning currently
- Even though there is good relationship with big CAE vendors, the current collaboration is minimal strategically
- The development resources are low
- Weak collaboration with Cybernet group subsidiaries
- Long sales cycle in a rapidly changing environment
- Low stuffed product and marketing teams

The current **opportunities** for Noesis are listed below:

- Higher demand for service projects from existing customers
- Acceptance of CAE methods in Research and Development departments
- Product recognition of the current portfolio seems to increase in local markets
- Synergies with Cybernet group subsidiaries to share technology, knowledge and activities
- Niche markets (e.g.: medical, pharma) start to use CAE methodologies
- Business with the Noesis core technology and not only with products and service projects
- Cloud based solutions is growing rapidly
- Digital business transformation is accelerated due to the COVID-19 pandemic

The current **threats** for Noesis are listed below:

- Traditional Automotive and aerospace technologies are declining currently. This trend is enhanced due to COVID19 pandemic
- Big business uncertainties due to the US-China trade war
- More often local vendors are preferred (e.g.: US competitor in US and Chinese competitor in China)
- Open-source competitive software gains more visibility
- Strong competitive products owned by bigger vendors
- Brexit trade uncertainty
- Traditional Process Integration and Design Optimization market seems to be saturated
- Key personnel may seek for another opportunities. Impact is bigger since Noesis is a small-medium sized enterprise

Since this assignment is carried out during the COVID-19 pandemic period and the economy is unstable worldwide, severe changes in big industries may force Noesis to update the current marketing plan before the end of the first year of the implementation with the new data that will occur towards the end of this pandemic.

Assumptions

The marketing audit that is performed in the previous pages shows that Noesis is currently operating in a fast-changing environment due to economical, social, political, and technological changes that affect the micro and the macro environment of the company. In the situation, some assumptions will be made before setting the objectives and the strategies of the current marketing plan:

- The S&A market and the industries will follow the growth that is shown in Figure 11 and in Figure 12
- The global economy will follow a trend close to the one highlighted in Figure 13

- Noesis will be part of the Cybernet group and it will be out of risk for a financial bankruptcy for the following 12-14 months due to unexpected economical factors
- Noesis is a relatively small company. It is expected that it will keep at least 95-100% of the current workforce

Phase 3: Strategy formulation

The Phase 3 is the last step for the marketing plan where the marketing objectives, the strategies and the tactics, and the expected results and the alternative plans are set. Consequently, this section will be separated in three parts accordingly.

Marketing objectives

In the Phase 1 of the current marketing plan, the goals that are set from the management of Noesis for the following period are mentioned. The marketing strategy that is proposed in the following section is supporting the corporate goals that Noesis has set. Briefly the goals for the next 3 years are:

- 23% average annual revenue growth for the next 3 years
- 15% minimum annual operational profit
- 45% new over existing business ratio
- Noesis to become a key player on the digital transformation of the S&A market and be a key partner for its customers

The current marketing plan will support the annual revenue growth and the increase on the new/existing business ratio. As it is analyzed above the, the main revenue stream of Noesis is based on software and services sales. The current product portfolio consists of one desktop-based software product. The target user was until now a highly skilled technical person that was working on a standalone product, like Optimus. To maximize the revenue stream, Noesis needs to have either more products or a software product that is targeting more user groups. Consequently, Noesis is going to have a different market approach that will gain more users and consequently will increase the profit, to achieve the growth rate that it is planned.

The current marketing plan will also bring Noesis as a key partner on the S&A market on the digital transformation. Noesis is a neutral vendor software vendor since the company was founded. This practically means that it maintains relatively good collaboration with other key players in the market but without bonding more with one against the other. Considering this and the high technology that Noesis has developed over the years, it can collaborate with various big manufacturers to help them with the digital transformation that has already started worldwide, with focus on the simulation and analysis.

Finally, a target of this marketing plan is to grow the Chinese and US market share and focus also on the development of the industries that are now starting to use simulation methodologies and are focusing on the digital transformation. China and US are two big markets, relatively unexplored for Noesis. On the other hand, it seems that the industries on those regions are extensively using S&A tools and are leading the digital transformation from that perspective. The revenue stream from the Chinese market is already high for Noesis and it needs to further grow. On the other hand, the US revenue is quite low despite the potentials. Additionally, the Automotive and Aerospace industries will remain on the focus of Noesis. Those two industries were the ones leading the S&A market already for 30 years. Practically, the S&A technologies got mature in those industries even though there were a lot of ups and downs until they are standardized. The new industries that are going to use them (e.g.: Medical/Pharma) are going to directly implement the best practices that are standardized in the market. Noesis needs to partner with companies that are newcomers in the S&A world and develop new business.

Marketing strategy

Products strategy

As it is mentioned above, the product portfolio of Noesis currently includes one product, Optimus, which is the legacy product of the company. The current marketing plan does not include changes on the product itself, apart from the fact that Noesis will keep investing on developing it by enhancing and advancing the main features that are making Optimus a leader in the PIDO field of the S&A market. Note that according to the Figure 24, it is estimated that currently Optimus can be considered as a “mature” product.

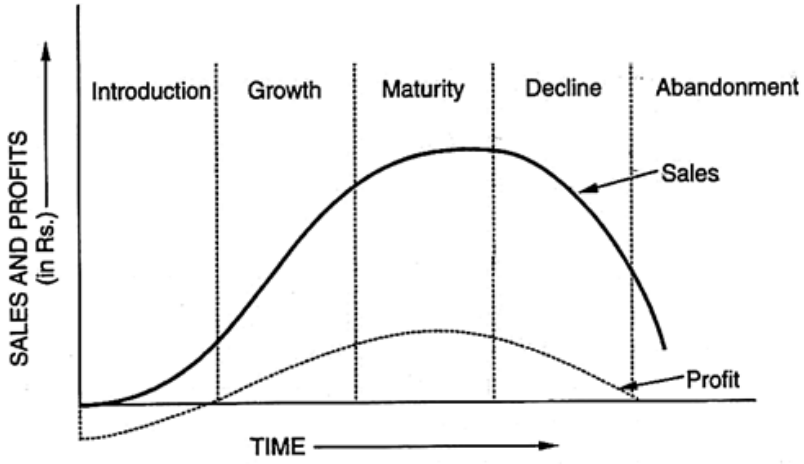

Figure 24:Product life cycle curve

Consequently, Optimus will remain a product in the portfolio of Noesis that will be targeted for B2B sales, with main target user groups the:

- Design optimization experts that are responsible to define the optimization strategies on their departments
- Process integration experts, that are integrating engineering processes that involve simulation and analysis tasks, to ensure product quality, robustness, and reliability.

On the other hand, Noesis the last years has developed a server-based platform that can host Noesis technologies. A product that will be packaged based on this technology will be the focus for this marketing strategy. This product will be called sFlow and it is the Noesis engineering collaboration platform.

The new software product is built based on an architecture that enables the deployment in a local computer, an HPC, a local server or in a cloud server. Its main components are the application server and the database that hosts all the data. Due to its architecture, it can be deployed either in Windows-based systems or Linux-based systems. If sFlow is centrally installed in-premise or in cloud, all the users that get access in it can access it using only a browser. The sFlow platform supports user, groups and roles management that will enable collaboration among different departments or users individually. The primary and secondary research revealed the need for a neutral vendor platform in the simulation industry and Noesis believes that sFlow will serve this purpose.

During the last years, Noesis has converted its core technology to core modules. It means that the technology is not tightly attached to a product, but products can be built using the Noesis modules as building blocks. Based on that, sFlow is an engineering platform that can host several engineering applications that are created based on the Noesis core blocks. As part of this marketing plan, two main applications are proposed to achieve the short-term goals:

- About **simulation execution.** This application is responsible to host engineering applications that involve the execution of simulation tasks, with focus on hiding the complexity of an engineering process. The simulation process will be authored by a simulation (or CAE) specialist and it will become available as an application wizard that can be followed by junior users or non experts in simulations (e.g.: Product Managers). This is a first big step towards the democratization of the simulation that Noesis wants to play a key role. Democratization of the simulation was indicated as the main

challenge faced by the industries in different sectors. This application will have all the tools, integrated to an intuitive user interface that allows use of the software in a guided environment.

- About **data analytics.** Wider use of simulation and analysis methodologies means production of bigger amount of data. Noesis offers with sFlow, an application that allows users to analyze their data and make decisions. The data can be produced either through sFlow or from another source and imported in sFlow. Noesis was never active in the past in the data analytics industry since one can find a wide spectrum of applications and technologies. Noesis is currently going to focus on the data analytics that are related to engineering applications since across the years technology has been developed in that direction. Consequently, a new market is now opening for Noesis with the sFlow data analytics application, that can be considered even a market segment separate to S&A.

The two applications mentioned above, are going to be offered by default when a customer buys sFlow. Although, due to the open architecture that is selected, Noesis can develop new applications in the future to be offered as part of sFlow or develop custom applications as a service for a customer/prospect.

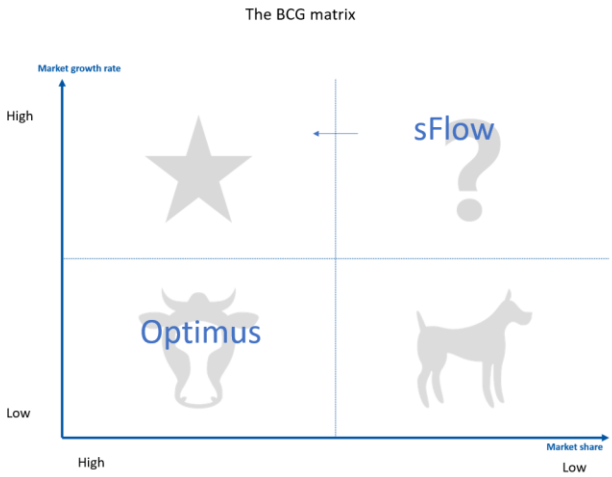

Figure 25:The BCG matrix for Noesis product portfolio

To summarize, the short-term product mix and the expectations regarding the market share (cash generation) and the market growth, the BCG matrix will be used (Figure 25). It is shown that Optimus is a cash cow currently and it is expected to stay like that for the next 3 years. The new platform, sFlow, it is expected to be a question mark since it is a newly introduced

product. The current marketing plan is set with the expectation that sFlow will become a star product after the end of the current plan.

This product strategy is mainly a developing strategy since it is designed to offer new products and services to existing customers. It is also expected that during the execution of this plan, prospects will be converted to new customers and this strategy will certainly help for that. As it is shown during the analysis of the primary data collected by the market research, there are several ways to separate the market segments of interest. This can be done, either by the industry that a company is active (e.g.: Automotive, Aerospace, Electronics) or geographically (e.g.: China, Japan, Europe, etc.). Additionally, other market segments can occur based on the penetration of the cloud technologies or the level of digitalization of the processes. In that case, this marketing plan will focus to grow the Chinese and US market since the penetration of the S&A technologies seem to be higher currently as the market research revealed. Additionally, the focus will remain on the Automotive, Aerospace and Electronics big customer of Noesis. The focus will be to work with them and help them with Noesis products and services to establish a strong S&A processes framework with sFlow as the basis product. Finally, no major changes apply to the market segments that Noesis will target with Optimus. The Figure 26 summarizes the Noesis product footprint as set by the current marketing plan:

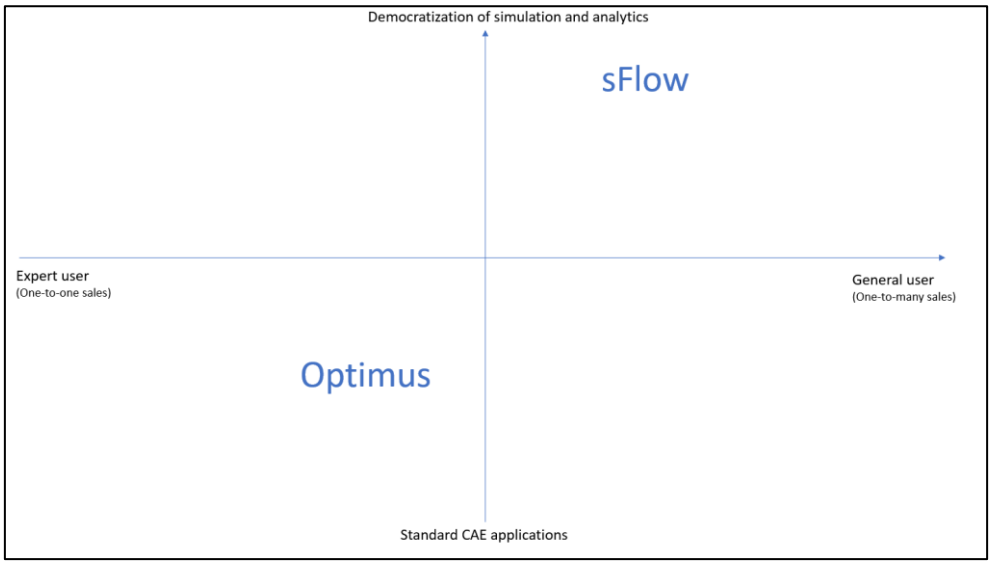

Figure 26:Noesis product footprint

Pricing strategy

In the previous section, the Product strategy that will be followed is presented. The new portfolio will include Optimus, as the legacy product of Noesis, and sFlow as the newly

introduced engineering platform. As it is already explained, the target user groups for those two products are different. The pricing strategy of Optimus will remain the same, as it is explained in the Phase 2. Below, the pricing strategy of sFlow is analyzed.

As it is explained above, sFlow is a software platform that can host several applications and the license schema will be defined accordingly. Every customer will buy the software in three parts. Firstly, the customer will pay a fixed amount for the platform itself, that will provide access to all the user, group, and role management systems. On top of that, a customer can buy a single or a suite of the offered applications (one for simulation execution and one for data analytics). Both applications have the same price. Finally, a customer can purchase additional functionalities in the form of software libraries. Those libraries unlock software features that are licensed. The Table 8 demonstrates the licensing schema.

In the secondary analysis, it is mentioned that for Optimus two traditional business models are followed regarding the licensing, the purchase, and the lease. For sFlow, only the lease option will be available. Consequently, customers must pay a fee yearly to renew the access to the software. The Table 8 shows the prices accordingly.

The distribution strategy below describes the way that sFlow will be offered as part of cloud providers, since this need was also highlighted during the primary market research. In this section, the pricing will be analyzed. Since sFlow is hosted in a cloud provider, the customer can access and use it in two ways. It is possible to bring-their-own-license, as part of the lease agreement mentioned above, or pay-as-they-go. An hourly rate is set per module and per user and it is paid while the user is using the software. The monitoring of the usage is hosted by the cloud provider administrator. Noesis gets the revenue monthly from the cloud provider. The Table 8 shows the proposed hourly rate accordingly.

Table 8:Licensing schema and price catalogue for sFlow

Description	**Lease Price (per user)**	**Pay-as-you-go (per user)**
Platform	25k€	-
Each Application	6k€	4€/h
Library	3k€	2€/h

It is proposed that Noesis follows a penetration pricing strategy. With this strategy, the prices are set lower compared to the competition. With this strategy the following goals are set:

- Win deals against the big software vendors. As it is explained above, those companies offer a wide portfolio and can make big discounts even though the total price can be relatively high. Since most companies do not select one singe software provider (results of the primary research), Noesis can be the platform that is selected for democratization of the simulation and automation and get fast a big market share.
- Have an attractive license package for traditional markets as the Chinese where the leasing is preferred and to the rapidly changing markets (e.g.: US market, as it is shown by the primary data) that are adopting fast new cloud-based solutions.
- Prevent competitors from entering the market. As it is mentioned, during the secondary analysis, some competitors have already introduced similar web platforms, but more focused in the traditional PIDO market segment. Having low prices, and a high market share will discourage other small software vendors to introduce server-based solutions as sFlow.
- Increase the revenue. Optimus is a product that is selling one-to-one. On the other hand, the sFlow license is per user. Consequently, the amount of licenses that are used can vary dynamically without the overhead of installing in the user machine every time since this adds extra IT cost. The target user group for sFlow is the general user and it is expected that the number of sales will increase due to this focus group. This is aligned with the marketing objectives set in the previous section.

Promotion strategy

The new engineering platform of Noesis, sFlow, is a new product that enters the S&A market segment with focus on the democratization of the simulation and on data analytics as part of the contribution of Noesis in the digitalization of the S&A industry. Several promotion and advertisement activities are scheduled and are described below.

First, the website of Noesis needs to be updated to host the new product and all the details around it. Even though in the primary research the website scored quite low, it is fundamental that the Noesis website describes the positioning of the new product and a summary of the functionalities that it offers. It is decided that sFlow addresses the challenges on the digital product development with focus on the democratization of the simulation and the analytics. This needs to be communicated clearly in the home page.

Additionally, Noesis needs to have a strong presence worldwide in industry-related conferences since this is a good place for public relations according to the primary research. Noesis can be a sponsor for some conferences, have a booth, submit papers with user cases based on sFlow and have a keynote. Depending on the region, conferences are organized per industry (e.g.: Automotive) or per applications (e.g.: renewal energy). Noesis needs to be present worldwide in conferences where the target user groups are present and can spread the word of the new product at their organizations.

The covid19 pandemic is still ongoing and it is not known when this exactly ends. Additionally, more and more people prefer digital ways to get informed, meet, learn, and produce. One of the promotion tactics that is strongly proposed for the promotion of sFlow is to organize a series of webinars. As it is also indicated by the primary research, a webinar is a way that many people select to get informed about a new technology or a product. A series of webinars can be organized either by Noesis individually to introduce the product and its functionalities or in a collaboration with a customer/prospect to show a real-life use case. It is critical for the webinar to have as many attendees as possible. To achieve that contact details should be acquired by distributors and partners to maximize the participant list.

Finally, since the product will become available through partnerships with one or more cloud providers, joint advertisements (e.g.: website posting, social media, webinars) should be organized with the partners since the benefits are mutual.

Place (distribution) strategy

The current distribution channels of Noesis are described in the marketing audit section above. As it is mentioned, Noesis is selling directly through sales representatives to customers, or via distributor partners that are responsible for the sales and the first line customer support. This strategy allows Noesis to have access to different markets worldwide with people that are experienced in the S&A market. Additionally, it is possible that some of the customers of the distributors are not yet Noesis customers, and this creates additional business potentials. Consequently, it is proposed that Noesis keeps the current distribution schema. It is assumed that all the sales representatives (Noesis and distributors), will be trained to sell the new product and all the required materials for promotion will be provided to them by Noesis.

Additionally, it is proposed that Noesis starts partnerships with selected cloud providers that are active in the S&A market, such as Rescale Cloud, Cybernet CAE Cloud, Onscale etc., to make available sFlow to the users of those platforms. It occurs from the primary results too, that some industries are shifting their operations to cloud against the current on-premises solutions. Fortunately, the list of cloud providers in the S&A market is not long and Noesis can easily make beneficial agreements. Consequently, all the customers of the cloud providers can see sFlow in the list of the available software, buy a pay-as-you-go license (as it is described in the pricing strategy) and start using sFlow. That way Noesis creates revenue, but the distribution is not through one of the standard Noesis sales channels as described previously.

Expected results and alternative plans

The Marketing Audit section reveals the details for Noesis. Even though the company has almost 20 years presence in the field, it had small portfolio and a relatively small team. It is also explained the way that the legacy product, Optimus was introduced in the market. Consequently, there is no recent experience of introducing new products in the market. For that reason, no safe predictions can be made based on recent experience. The marketing strategy presented before is only based on the secondary and primary data analysis and not in previous known situations.

Due to the lack of previous experience and due to the rapidly changing environment, some correction plans need to be defined that will adjust the current marketing plan and ensure its success. Below 4 different scenarios are analyzed:

- **COVID19 financial consequences.** The current marketing plan is defined during the COVID19 pandemic. During the secondary data analysis, the projections of the S&A market growth are presented and the predictions for the global economy for the following years after the pandemic. Since the plan for the vaccination is still not robust and there are many factors that can affect the global economy, the risk that the S&A market may be affected in total is high. In the case that the market declines due to financial reasons, Noesis needs to establish some strong partnerships for sFlow. It is proposed that some strategic prospects that want to proceed with the digitalization of the industry, given the shaking global economy, will be selected and Noesis will try to collaborate with them in a partner level instead of a customer-vendor level. Even

though the total revenue for sFlow will decrease, Noesis will get some knowledge by the deployment of sFlow in one or more organizations in a technical, IT and customer support level. Consequently, after the COVID19, Noesis will be much more experienced and ready to penetrate the market massively.

- **Loss of workforce and partners/distributors.** The financial situation that is described just above can affect not only the potential customers but the partners too. Due to the financial crisis of the current period, some of the distributors of Noesis that base their revenue on service projects mainly, may experience severe revenue loss during this period. That may result in changing their business plan and stop the collaboration with small software vendors like Noesis or even go bankrupt. In that scenario, the impact to Noesis will be quite big especially if the distributor is located on regions that Noesis is focusing more its business. Given that scenario, the Noesis sales team need to act rapidly and get the contacts of Noesis customers from the distributor and set up a quick plan of transferring the sales activities and the customer support from the distributor to Noesis. That way the impact may be minimized since the customers will be informed and engage on a sales process about sFlow with the specialized personnel of Noesis. The current and the following period are unstable not only for the companies, but also for the workforce since a lot is changing in the labor conditions too. Noesis has a small development and customer support team that needs to be extended but in case the development team quits massively, no time should be lost to finalize sFlow before the final release on the market. In that case, Noesis can collaborate with an IT consultancy where a custom development team can be created to contribute to the development of sFlow.
- **China - US trade war.** This economical and political situation is also analyzed during the marketing audit. It is still unclear how it will continue after the election of the new US president. In case this trade war remains, China may promote the buyers to switch to domestic technology vendors [26]. Noesis is not an American company but the software products contain technological components that are produced from American companies and are compiled in a product outside China. In the case that the Chinese government applies stricter rules, Noesis needs to react fast since the business in the Chinese market is of high importance for the current marketing plan. To overcome this barrier, Noesis needs to produce sFlow as a domestic Chinese

product and distribute it in the Chinese market. Since Noesis owns an office in China, it is possible to setup some basic IT infrastructure that allow Noesis to compile the source code according to the regulations of the Chinese government to be considered as a domestic version of the product. This strategy will allow Noesis to keep developing the actions that are planned and grow the business in the Chinese market.

- **Intensified competition.** During the secondary analysis, the competition is analyzed and the tactics of the big software vendors that are active in the market are mentioned. In case the competition offers good discounts and services, those products can be preferred from an organization since the fact that an entire solution is offered may be attractive. In that case, Noesis will have to strengthen the promotion and highlight the fact that is a neutral software vendor, responsive to the customer requests as highlighted from the SWOT analysis. Additionally, one of the main advantages of the sFlow platform is the fact that it can integrate 3rd party software from different vendors. The use of software from multiple vendors and its importance is also highlighted from the primary research data and consequently Noesis can get an advantage towards competition. Promotion and positioning message should be intensified against competition in that scenario.

Phase 4: Resource allocation and monitoring

The Phase 4 is the last phase of this marketing plan and it contains three subsections, the definition of the action plan, the budget of the plan and a monitoring system that is applied during the execution.

The action plan

The action plan defines the actions that need to be performed to materialize the marketing strategy that is defined above. It contains a set of actions related to product, promotion, place and price, the timeline that each action will be performed (start-end) and the responsible team that needs to initiate and/or perform the action within the set timeframe. The Table 9 shows the action plan of the current marketing strategy. In the left side of the table, the list of actions that is defined in the marketing strategy section, in the middle the timeline (time intervals are shown in grey) and in the right side of the table the responsible team is indicated.

As it is already mentioned above, Noesis has already developed the biggest part of the technology needed to support the current marketing plan. Even though the beginning of the

plan is set for 2021, it is assumed that Noesis will still spend some development time in 2021 to finalize the first release of the product in the market. It is also considered that the first sales to customers can already start within 2021 (see the budget below).

The Table 9 shows an overview of the actions that are needed for the following period after the start of the marketing plan. Each of the tasks will be documented separately and it will be detailed even further in tasks by the responsible teams. It is not in the scope of the current assignment to present the details of the subtasks.

Table 9:Master schedule for the marketing plan

Action plan													
	Timeline												
	2021				2022				2023				
Actions	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Responsible team
sFlow – UX/UI final design													Product
sFlow – platform final development													Development
sFlow – Application 1 final development													Development
sFlow – Application 2 final development													Development
sFlow – Graphics (logo)													Marketing
sFlow – Promotion materials													Marketing/Product
sFlow – cloud licensing technology													Development
sFlow – cloud deployment													Development
Website extensions													Marketing/Product
New conference booths													Marketing/Product
Webinars													Marketing/App.Eng
Sales team and distributors training													Sales/Product

The budget

This section is presenting the budget of the current marketing plan. It does not only justify the feasibility of the current plan, but also the fact if the plan is cost effective. The Table 10 shows the overview of the budget estimation for the 3year plan. The key items of the budget plan are[6]:

- The **invoices sales**, which represent the entire revenue stream earned during the year from the trading operations of the organization related to this marketing plan
- The **cost of sales,** which represent the direct costs of making the product that is sold as part of the current marketing plan and it mainly contains labor and material costs
- The two values above result to the **gross profit,** that gives a direct comparison between what the product can be sold and what is the cost to make it.

- The **operating expenses**, that contain all the sales and marketing costs, advertising, promotion, administration costs etc.
- Combining all the values above, the **operating profit** is calculated, which is a key figure in the accounts. This measure will be used to decide for the success or the failure of the current marketing plan

It can be seen in the Table 10 that the current plan shows a loss in the first year and it only breaks even in the second year. This is normal since as it is mentioned before, during the first year some extra investments need to be made to finalize the product and prepare its launch in the market. According to the budget the break even happens quite early since the current budget does not consider the costs of the development of the Noesis platform until the beginning of 2021. In case that this was considered the break-even point would be in year 3.

Table 10:Budget of the marketing plan

Budget			
	2021 (k€)	2022 (k€)	2023 (k€)
Invoiced direct sales	504	824	1021
Invoiced indirect (30% of total revenue)	123	210	233
Cost of sales	700	400	400
Gross profit	-73	634	854
Operating expenses	360	467.5	479.5
Sales and Marketing costs			
Salaries	300	400	400
Website update	10		
Recruitment	10		
Travel	30	50	60
Cars/Fuels	5	7	7
Product materials	2	0.5	0.5
Administration costs			
Market research costs		5	5
Product distribution costs	3	5	7
Operating profit (related to this plan)	-433	166.5	374.5

The plan monitoring

The current marketing plan is based on the detailed analysis of the macro and micro environment of Noesis, in the analysis of the data collected from the primary research and the action plan that is budgeted as presented above. Even though the analysis is detailed, the marketing plan is not written in the stone and a monitoring system should be put in place.

For the monitoring, a small team will be formed that will establish the standards that relate with the sales and costs and with the timescales of the action plan. The monitoring team will meet once per month after getting feedback from the various departments that are involved in the different tasks of the action plan. Except from the tasks of the action plan, the sales number should be collected before the meeting.

In the beginning of the plan, the monitoring team will break the different actions and sales goals in smaller measurable intervals of each month. Thus, a set of standards will be created, and this will be the guideline for the successful implementation of the marketing plan. Each month the monitoring team should evaluate and report the performance. Practically that means the comparison of the actual data that are collected at that moment with the standards that are set in the start of the plan.

The last and most important task of the monitoring team is to propose correcting measures when deviations from the standards are identified. During the definition of the standards, the tolerance for every action should be defined since the actual performance can never match exactly the standards. The correcting measures needs to be communicated in the team leaders of each team and they will be responsible to implement them according to the suggestions of the monitoring team. Finally, the monitoring team needs to evaluate if the standards need to be reconsider depending on the level that the corrections change a lot the initial plan.

Chapter 4 : Bibliography

[1] Michael E. Porter, “30. HBR ’ s Must-Reads on Strategy,” *Harv. Bus. Rev.*, vol. 1, pp. 1–143, 1996.

[2] R. Varadarajan, “Strategic marketing and marketing strategy: Domain, definition, fundamental issues and foundational premises,” *J. Acad. Mark. Sci.*, vol. 38, no. 2, pp. 119–140, 2010, doi: 10.1007/s11747-009-0176-7.

[3] G. S. Myers, “What Is Marketing Defining A Market Market Research Marketing Mix Writing A Marketing Plan Marketing Plan Outline Marketing Strategies Test and Track Implementation,” 2014, [Online]. Available: http://extension.umd.edu/agmarketing.

[4] M. Mcdonald, “Strategic marketing planning: Theory and practice,” *Mark. B.*, pp. 87–116, 2012, doi: 10.1016/b978-0-7506-8566-5.50009-1.

[5] T. Hill and R. Westbrook, “SWOT Analysis: It’s Time for a Product Recall,” *Long Range Plann.*, vol. 30, no. 1, pp. 46–52, 1997, doi: 10.1016/S0024-6301(96)00095-7.

[6] J. Westwood, *How to write a marketing plan.* 2013.

[7] M. D. Jain, S., Haley, G., Voola, R., & Wickham, *Marketing: Planning and Strategy.* 2012.

[8] D. K. Gurley, G. B. Peters, L. Collins, and M. Fifolt, “Mission, vision, values, and goals: An exploration of key organizational statements and daily practice in schools,” *J. Educ. Chang.*, vol. 16, no. 2, pp. 217–242, 2015, doi: 10.1007/s10833-014-9229-x.

[9] “Cybernet Systems Product & Services.” https://www.cybernet.jp/english/products/.

[10] “Cybernet System Group Subsidiaries.” https://www.cybernet.jp/english/company/about/group/.

[11] “Noesis Optimus.” https://www.noesissolutions.com/our-products/optimus.

[12] M. E. Dobbs, “Guidelines for applying Porter’s five forces framework: a set of industry analysis templates,” doi: 10.1108/CR-06-2013-0059.

[13] “Porter’s Five Forces | Market Info Group.” https://www.marketinfogroup.com/methods/porter-s-five-forces.

[14] “PLM Market Analysis Report Series - CIMdata.” https://www.cimdata.com/en/research/plm-market-analysis-report-series.

[15] “CIMdata Publishes Executive PLM Market Report - CIMdata.”

https://www.cimdata.com/en/news/item/13848-cimdata-publishes-executive-plm-market-report.

[16] “CIMdata Publishes 2019 PLM Industry Analysis Report.” http://www.dailycadcam.com/cimdata-publishes-plm-industry-analysis-report-2/.

[17] “CIMdata Releases 2019 Simulation & Analysis Market Report - Digital Engineering 24/7.” https://www.digitalengineering247.com/article/cimdatareleases-2019-simulation-analysis-market-report.

[18] “What elevated levels of political risk mean for business in 2021.” https://www.ey.com/en_be/geostrategy/what-elevated-levels-of-political-risk-mean-for-business-in-2021 (accessed Jan. 22, 2021).

[19] International monetary Fund, “A Long and Difficult Ascent, Executive Summary, World Economic outlook, October 2020,” no. October, 2020, [Online]. Available: https://www.imf.org/en/Publications/WEO/Issues/2020/09/30/world-economic-outlook-october-2020.

[20] “IMF: ‘Less severe’ but ‘still deep’ recession predicted | | UN News.” https://news.un.org/en/story/2020/10/1075282 (accessed Feb. 04, 2021).

[21] “OECD: Global GDP to return to pre-pandemic levels in 2021 | Business| Economy and finance news from a German perspective | DW | 01.12.2020.” https://www.dw.com/en/covid-vaccine-coronavirus-global-economic-recovery-for-2021/a-55775341.

[22] UN Department of Economic and Social Affairs (UNDESA), “Inequality in a Rapidly Changing World,” *World Soc. Rep. 2020*, p. 216, 2020.

[23] “Chi-Square Test of Independence - SAS Tutorials - LibGuides at Kent State University.” https://libguides.library.kent.edu/SAS/ChiSquare (accessed Feb. 04, 2021).

[24] M. T. Gürel, Emet, “SWOT analysis: a theoretical review,” *J. Int. Soc. Res.*, vol. 10, no. 51, pp. 5–9, 2017.

[25] “40 Powerful SWOT Analysis Templates & Examples.” https://templatelab.com/swot-analysis-templates/ (accessed Feb. 04, 2021).

[26] “Beijing orders state offices to replace foreign PCs and software | Financial Times.” https://www.ft.com/content/b55fc6ee-1787-11ea-8d73-6303645ac406.

Appendix

This chapter contains the questionnaire, the Python script source code and the validation of the Python code with SPSS.

Market research questionnaire

Marketing plan: An exploration of the Simulation and Analysis market

Dear participant, my name is Georgios Papantonakis and I am a postgraduate student at International Hellenic University (Master in Strategic Product Design). For my dissertation, I am creating a marketing plan and I am inviting you to participate in this study by completing the following survey. The purpose is to collect market insights for the Simulation and Analysis market segment. The results of the market research analysis will be used to create a marketing strategy plan.

The following questionnaire will require approximately 8 minutes to complete.

The data that is collected will be treated confidentially. If you choose to participate in this questionnaire, please answer all questions as honestly as possible. If you require additional information or have questions please contact me at the email listed below
gpapantonakis@ihu.edu.gr
Thank you in advance for your participation

About virtual product development

Virtual product development refers to a set of practices for developing and prototyping products in a completely digital 2D/3D environment. It has 4 main components, the design, the simulation, the staging and the digital manufacturing. The purpose of this section is to collect data for the virtual product development status at your organization with focus on the simulation and analysis.

Please provide one or multiple answers for the following group of questions.

1. Each enterprise can be active in single or multiple industrial sectors. What is the main industrial sector that your department is specialized in?

Tick all that apply.

- [ ] Automotive and/or automotive parts
- [ ] Aircrafts and/or aircraft parts
- [ ] Optical devices (lenses, parts, plates)
- [ ] Electronics
- [ ] Electric motors
- [ ] Industrial robots

Other: [ ] _____

2. The development of new products usually requires several simulation analyses. What is the type(s) of simulation analysis that you perform for your tasks?

Tick all that apply.

- [ ] 2D/3D structures
- [ ] Structural fatigue and durability
- [ ] Computational Fluid Dynamics (CFD)
- [ ] Thermal and heat transfer analysis
- [ ] Electromagnetic analysis
- [ ] Acoustic analysis
- [ ] Lighting analysis
- [ ] Noise and vibration analysis

Other: [ ] _____

3. Currently there are several big and smaller vendors that provide software for simulation. Who is currently your main simulation and analysis software provider(s) at your department?

Tick all that apply.

- [ ] MSC
- [ ] Siemens
- [ ] Dassault Systems
- [ ] Ansys
- [ ] Altair
- [ ] PTC
- [ ] ESI Group
- [ ] Autodesk

Other: [ ] _____

4. It is common that enterprises select one or more big software vendors for simulation and analysis tools. At your organization, is there a single big vendor selected across the different departments that perform simulation and analysis tasks?

Mark only one oval.

- ◯ Yes
- ◯ No

Evaluate the next group of questions on a scale from 1-5, with 1 being the Totally Disagree and the 5 being the Totally Agree.

5. The integration of simulation processes and data across multiple-physics disciplines in a single software platform, is a challenge at my organization.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

6. Managing and reusing better the simulation models and related design results is a challenge at my organization (Simulation Process and Data Management - SPDM).

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

7. The wide availability and usage of the simulation and analysis tools to support justified and valid engineering decisions (Democratization of the simulation) is a challenge that my organization faces.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

8. The creation and use of a cross-domain digital representation of a system or product (i.e: digital twin) is a challenge for my organization.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

9. Merging modeling and simulation technologies with traditional system engineering practices (Model-based system engineering - MBSE) is a challenge that my organization handles.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

10. The simulation process integration and automation technologies can help me to address challenges that I face with my tasks.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

11. Advanced design of experiment technologies can help me to address my challenges.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

12. Efficient and intuitive design optimization methodologies can help me to deal with challenges that I face with my tasks.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

13. Data modeling methodologies (e.g: surrogate modeling, regression, interpolation, etc) can help me and my organization to handle current challenges.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	TotallyAgree

14. Using advanced data analytics and visualization methodologies can help me to deal with the challenges at my daily work.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

15. How do you get informed for the new technological trends in the simulation and analysis market?

Tick all that apply.

- ☐ Websites (forums, blogs, google search)
- ☐ Webinars
- ☐ Magazines
- ☐ Linkedin
- ☐ Social media
- ☐ Conferences
- ☐ From my colleagues
- ☐ From the techical department of my organization

IT and digital transformation

According to recent data, businesses are spending a significant part of their IT budget on digital transformation of the enterprise in order to bring together the physical world and the digital world. The purpose of this section is to collect data for the level of the digital transformation and the IT infrastructure at your organization

Evaluate the next group of questions on a scale from 1-5, with 1 being the Totally Disagree and the 5 being the Totally Agree.

16. The simulation and analysis tools that are used in my organization are sufficiently integrated in one platform.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

17. The calculation resources that are required to perform efficiently simulation and analysis tasks are currently sufficient for my organization.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

18. My organization is currently encouraging the storage of simulation and analysis data in one or more cloud providers.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

19. My department is currently encouraging to access simulation and analysis software through a cloud provider for the main tasks that are performed.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

20. My organization is investing in using simulation and analysis software as a service (SaaS).

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

21. The collaboration for the product decision making across departments and colleagues, is currently done via a software platform at my organization.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

22. The exchange of data and the collaboration with external partners (e.g: OEMs, engineering services etc) is hosted through an engineering platform that is used in my organization.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

23. During the COVID-19 pandemic teleworking became necessary for many organizations worldwide. The access to software licenses available to the employees working remotely, was sufficient for your tasks.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

24. The IT department that manages the infrastructure at my company enables changes that allow the deployment of new software products.

Mark only one oval.

	1	2	3	4	5	
Totally Disagree	◯	◯	◯	◯	◯	Totally Agree

25. How is the IT infrastructure managed in your organization?

Mark only one oval.

- ◯ Internal IT team
- ◯ External IT service provider

General

In this section you can answer questions for organization and your role in it.

Please provide one answer for the following group of questions.

26. What is the main industry that your company operates?

Mark only one oval.

- ◯ Aerospace and Defence
- ◯ Automotive and Other transportation
- ◯ Electronics
- ◯ Medical/Pharmaceutical
- ◯ Oil and Gas (petrochemical)
- ◯ Construction/Infrastracture
- ◯ Other: _____

27. How many employees does your company currently employ worldwide?

Mark only one oval.

- ◯ 50 or less
- ◯ 51-100
- ◯ 101-500
- ◯ 501-5000
- ◯ 5001 and more

28. How many employees work currently at your department/division?

Mark only one oval.

- ◯ 1-10
- ◯ 11-20
- ◯ 21-50
- ◯ 51-100
- ◯ 101-500
- ◯ 500 and more

29. What is your role in the company?

_____

30. Where are you currently employed?

Mark only one oval.

- ◯ Europe
- ◯ USA/Canada
- ◯ Latin America
- ◯ China
- ◯ Japan
- ◯ India
- ◯ Other

31. Where is the headquarters of your organization?

Mark only one oval.

- ◯ Europe
- ◯ USA/Canada
- ◯ Latin America
- ◯ China
- ◯ Japan
- ◯ India
- ◯ Other

32. What is your age group?

Mark only one oval.

- ◯ 18-25
- ◯ 26-35
- ◯ 36-45
- ◯ 46-55
- ◯ 56-65

33. What is your level of education?

Mark only one oval.

- ◯ High school diploma
- ◯ Bachelor's degree
- ◯ Master's degree
- ◯ Doctoral degree
- ◯ Post-doctoral degree
- ◯ Other: _____

Thank you for your participation

Python script

The following Python code was used to produce the results of the Chi-Square test. For all the variable combinations in pairs, the X^2, the degrees of freedom and the p-value is calculated. A matrix with the p-value (Figure 22) is produced and exported in Excel with the p-values that determine the significance of the results.

```
import os
import pandas as pd
from scipy import stats as ss
import xlsxwriter as xl
#####################################################
SOURCE_DATA_PATH = r'C:\Users\gpapa\Desktop\SPD\Thesis'
SOURCE_DATA_FILE = r'Marketing plan_ An exploration of the Simulation and Analysis market_c
ross_tab_simplified.xlsx'
CROSSTAB_DATA_FILE = r'final_crosstab.xlsx'
SHEET_NAME = 'CrossTab'
#####################################################
excel_data_df = pd.read_excel(os.path.join(SOURCE_DATA_PATH,SOURCE_DATA_FILE))
# Workbook is created
wb = xl.Workbook(os.path.join(SOURCE_DATA_PATH,CROSSTAB_DATA_FILE))
# add_sheet is used to create sheet.
ws = wb.add_worksheet(SHEET_NAME)
# cross tabulation and Chi test
column_count = 1
for col1,_ in excel_data_df.iteritems():
    ws.write(column_count, 0, col1)
    ws.write(0, column_count, col1)
    row_count = 1
    for col2,_ in excel_data_df.iteritems():
        cross_tab = pd.crosstab(index=excel_data_df[col1], columns=excel_data_df[col2])
        x_2,p,dof,_ = ss.chi2_contingency(cross_tab)
        ws.write(column_count+1, row_count+1, str(x_2)+ " ,"+ str(p) + " ," + str(dof))
        ws.write(column_count+1, row_count+1, p)
        row_count += 1
    column_count +=1
wb.close()
```

Python code validation – Results' validation

To ensure that the results that are produced from the Python code are correct, a validation with the results produced in SPSS is performed. Two pairs of variables are randomly selected. The Chi-Square test is performed in SPSS and using the Python code and the results are shown below.

To perform the validation, the raw data that are exported from the Google Forms in an Excel sheet were imported in SPSS Statistics. The variables were identified and the correct type is assigned. The last step was to perform the analysis for a pair of variables and perform the Chi-square as the test to

be performed.

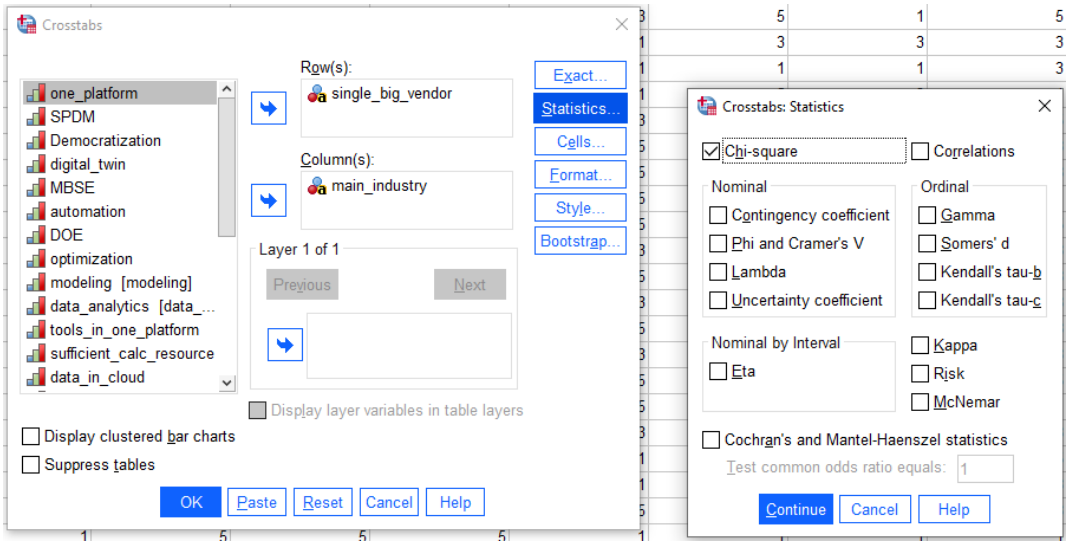

Figure 27: SPSS validation process

SaaS – data_in_cloud

Result from SPSS:

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.051[a]	4	<,001
Likelihood Ratio	20.636	4	<,001
Linear-by-Linear Association	11.738	1	<,001
N of Valid Cases	48		

Figure 28: SPSS validation test 1

Result from Python code:

```
Chi-Square tests results for  the variable SaaS and data_in_cloud is:
X^2 value is:  19.050984103615683
p-value is:  0.000768022197248784
Degrees of freedom are:  4
```

Figure 29: Python code validation test 1

Simulation_in_cloud – HQ_location

Result from SPSS:

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.184[a]	6	.083
Likelihood Ratio	11.521	6	.074
N of Valid Cases	48		

Figure 30: SPSS validation test 2

Result from Python code:

```
Chi-Square tests results for  the variable simulation_in_cloud and HQ_location is:
X^2 value is:  11.183985594237694
p-value is:  0.08285387793575431
Degrees of freedom are:  6
```

Figure 31: Python code validation test 1